IIT KHARAGPUR

NPTEL ONLINE
CERTIFICATION COURSES

COMPUTER NETWORKS AND INTERNET PROTOCOLS

Introduction

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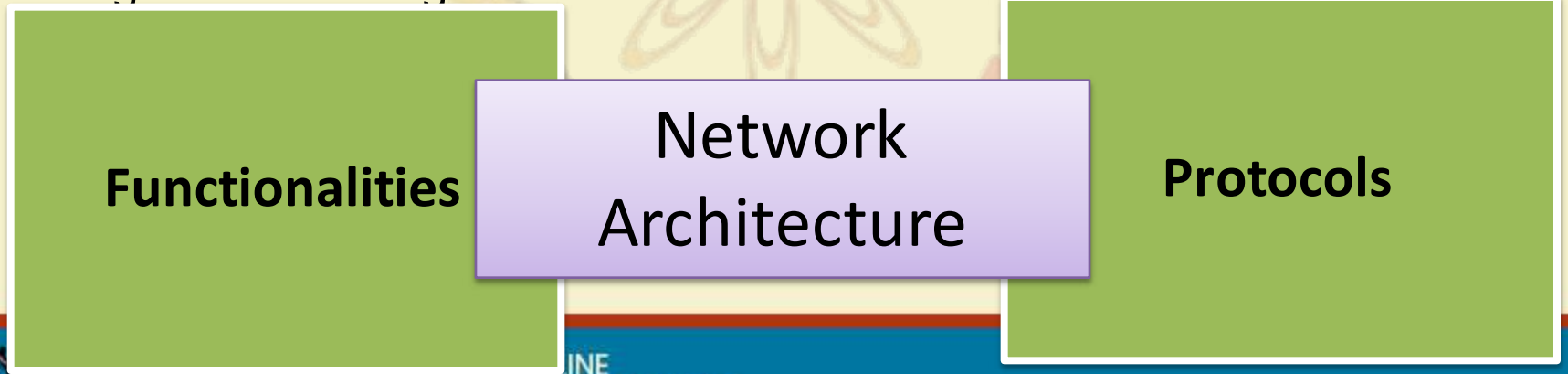
Objectives of the Course

- Understand how two computers in the Internet talk to each other
- Go through the basic functionalities of the computer networks
- Learn how to program the network
- Learn the future of the computer network – Do we need any further changes in the design?

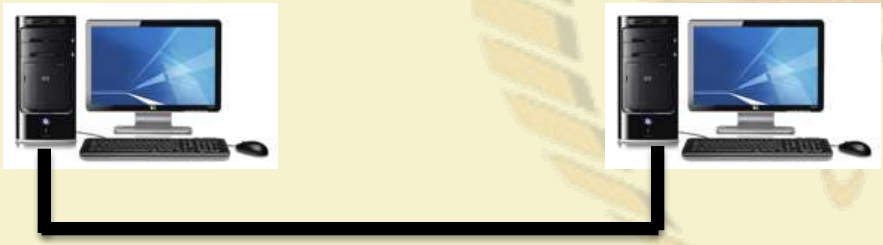


So, What is Network Architecture?

- A way to visualize how two remote computers talk to each other

Network Protocol Stack

What is Network Architecture? (contd…)

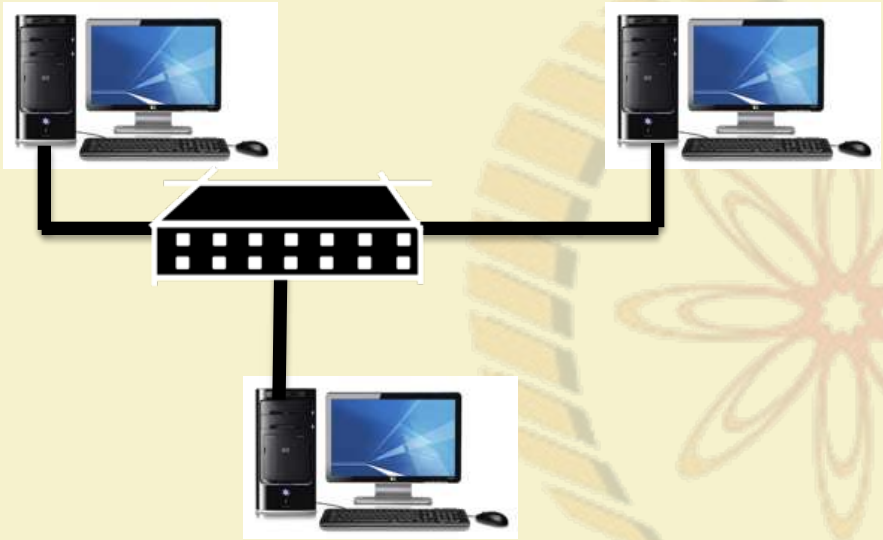


What is Network Architecture? (contd…)

Requirement: Convert digital data to analog signal and vice versa

Physical

What is Network Architecture? (contd…)



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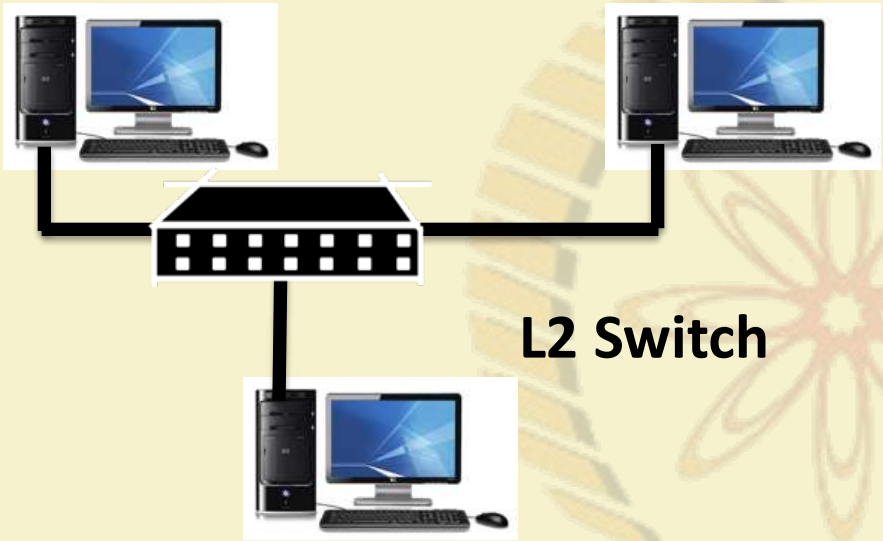
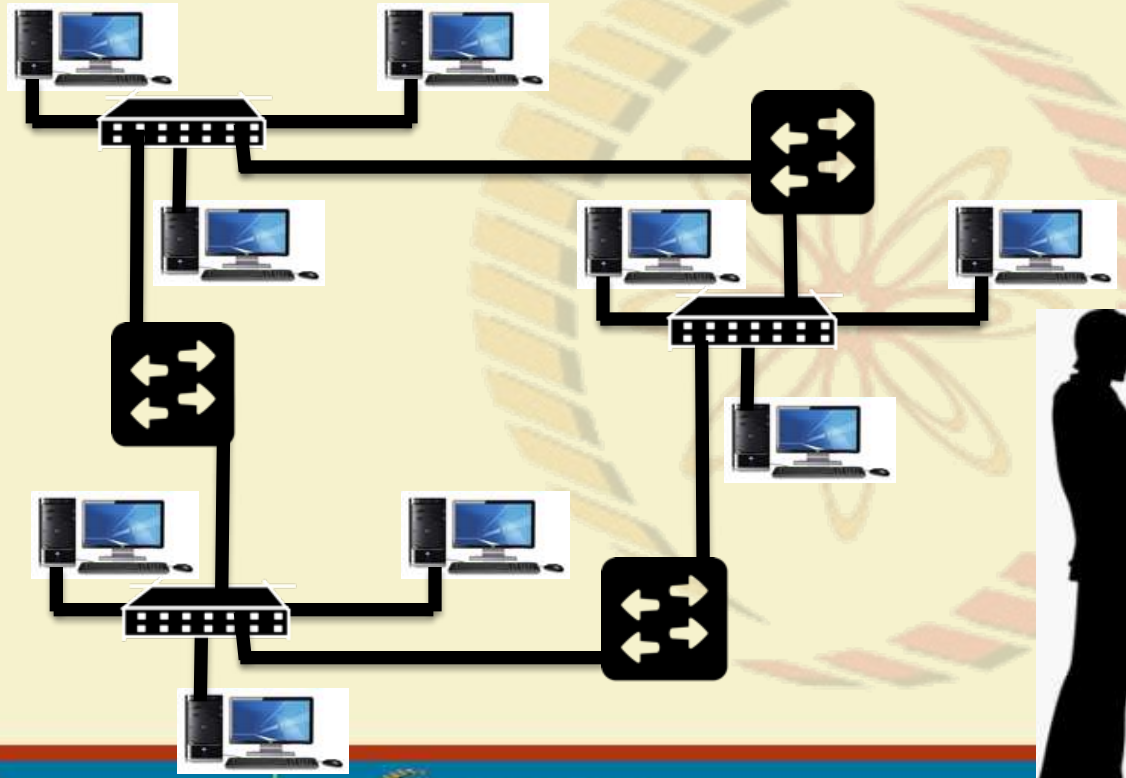


Requirement: Ensure proper scheduling in media access

Data Link

Physical

What is Network Architecture? (contd…)



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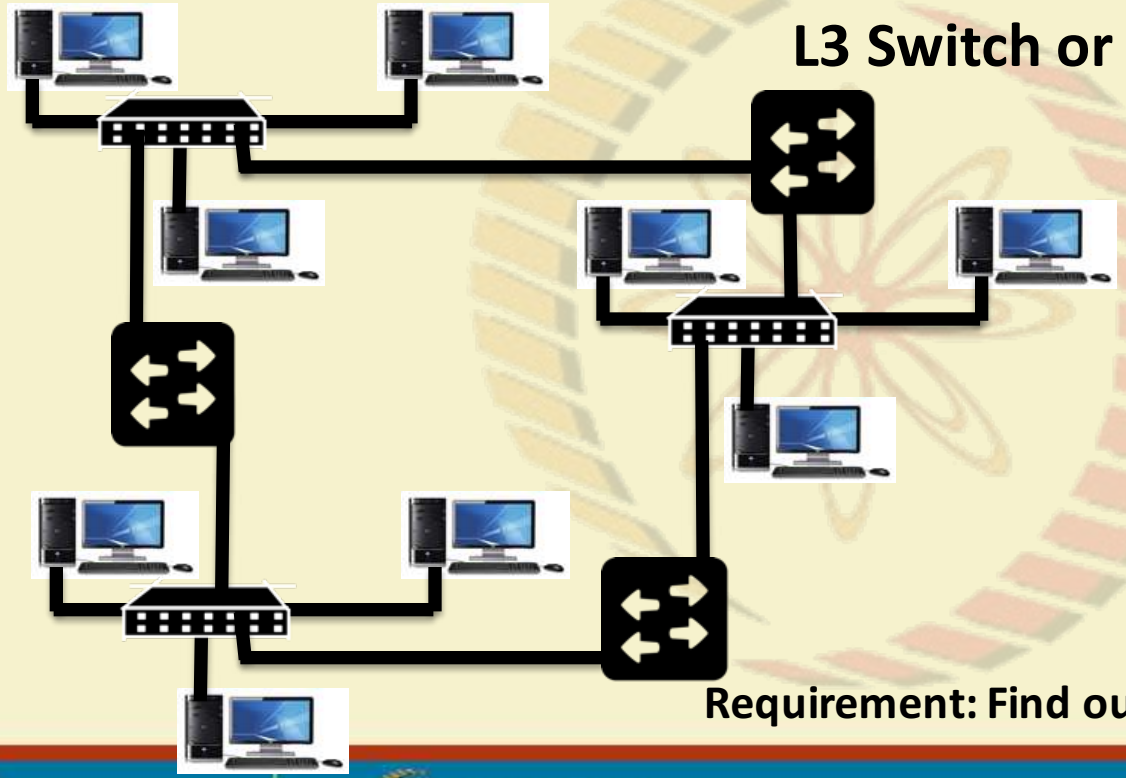


L3 Switch or Routers

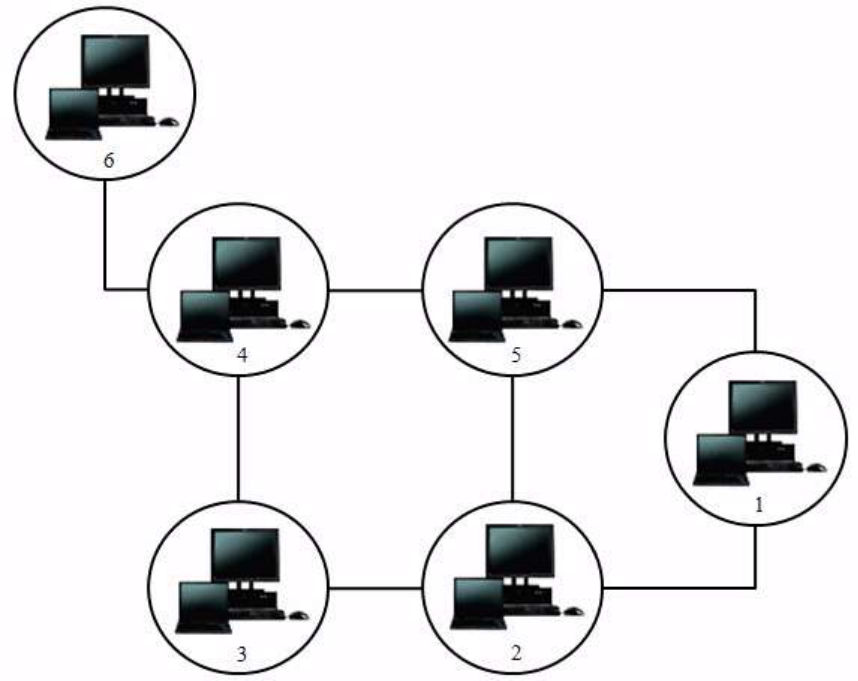
Network

Data Link

Physical

Requirement: Find out a suitable path to forward data

What is Network Architecture? (contd…)



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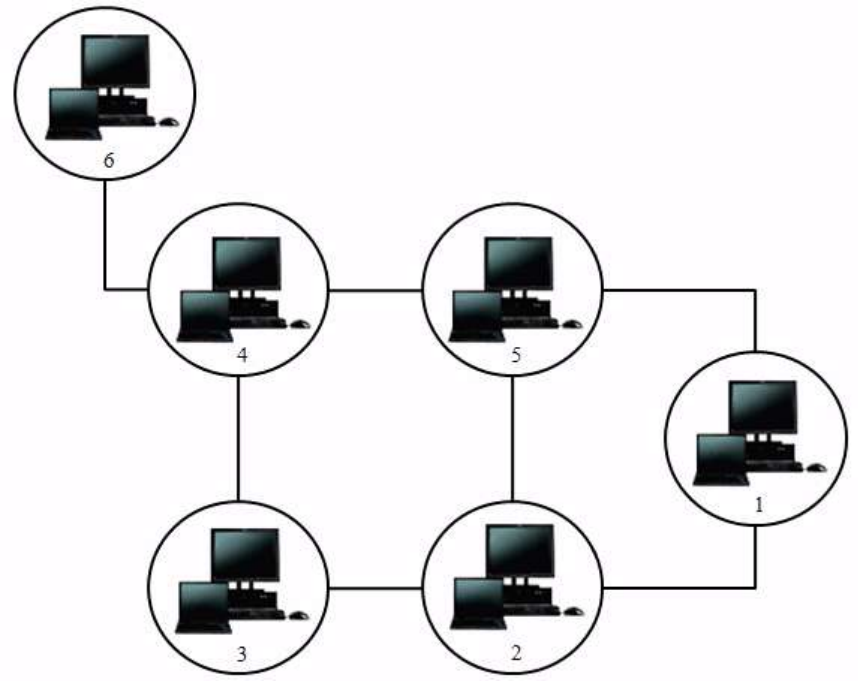


- Transport
- Network
- Data Link
- Physical

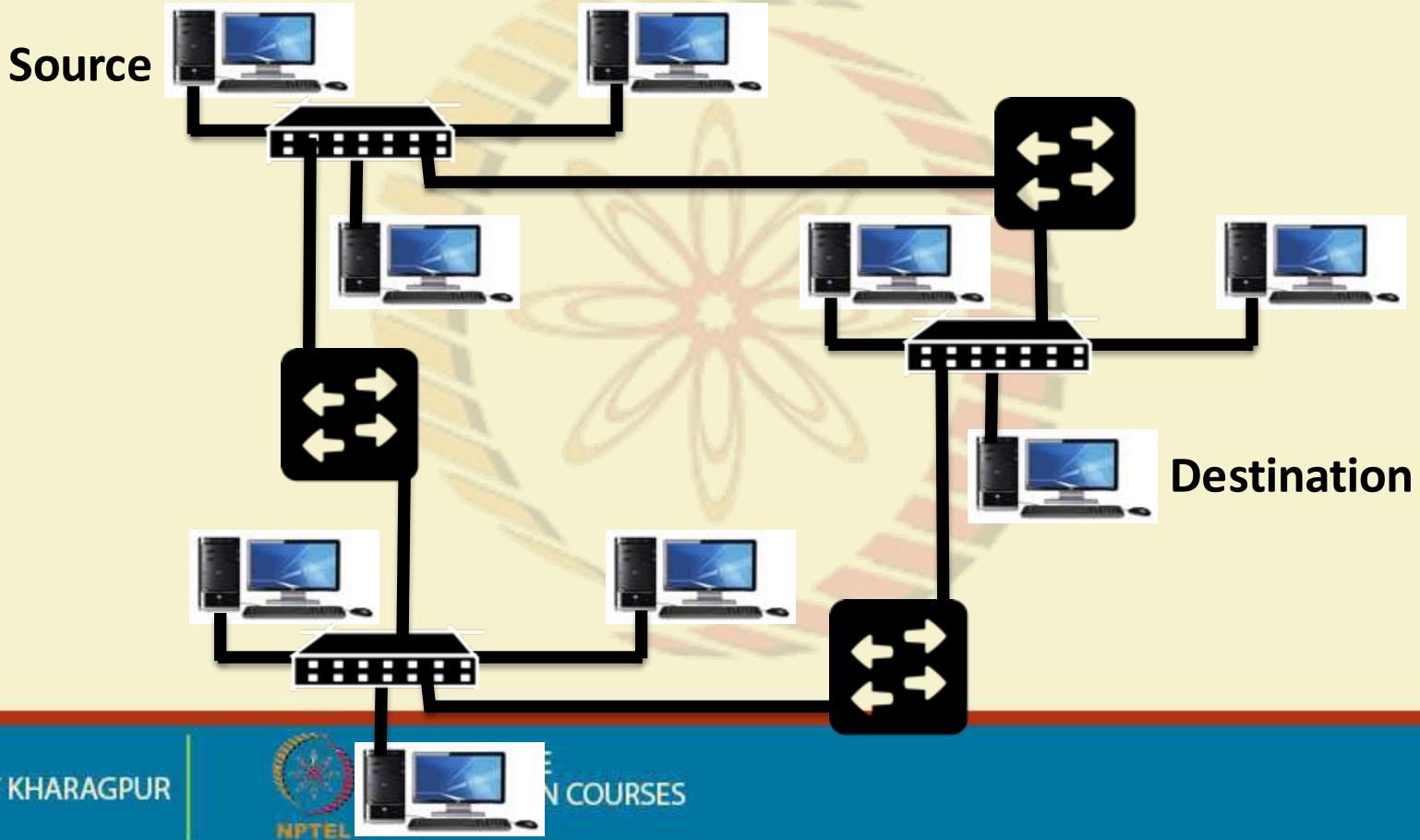
Requirement: End to end traffic control in the network

What is Network Architecture? (contd…)

Network Protocol Stack

- Application
- Transport
- Network
- Data Link
- Physical

Data Transfer between Two Remote Machines



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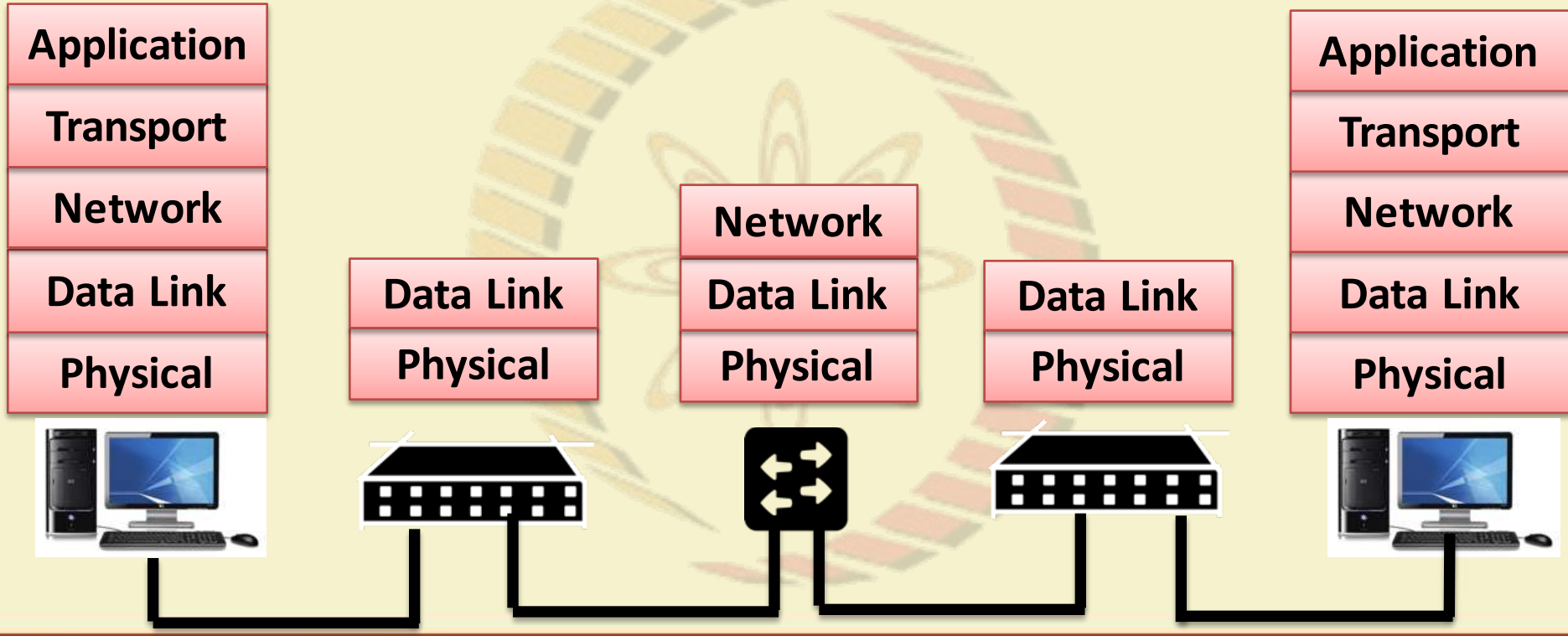
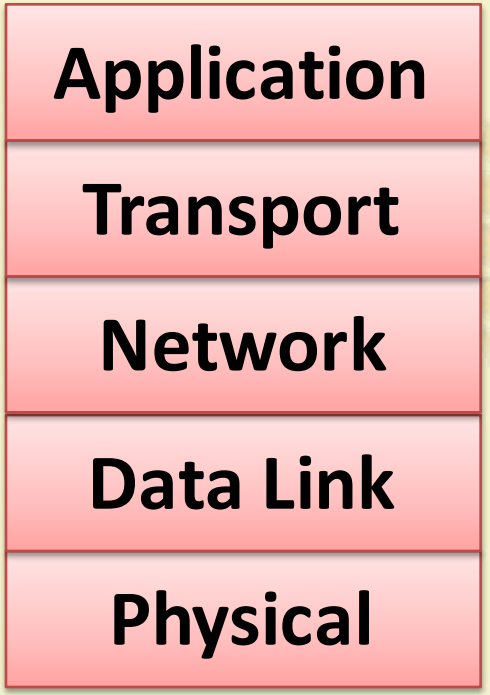


Protocols at Different Layers

Application	HTTP, FTP, SMTP
Transport	TCP, UDP, RTP
Network	IPv4, IPv6, MPLS
Data Link	Ethernet, WiFi, Bluetooth, UMTS, LTE
Physical	

Network Management and Control – Cross Layer Protocols



HTTP, FTP, SMTP

DNS

TCP, UDP, RTP

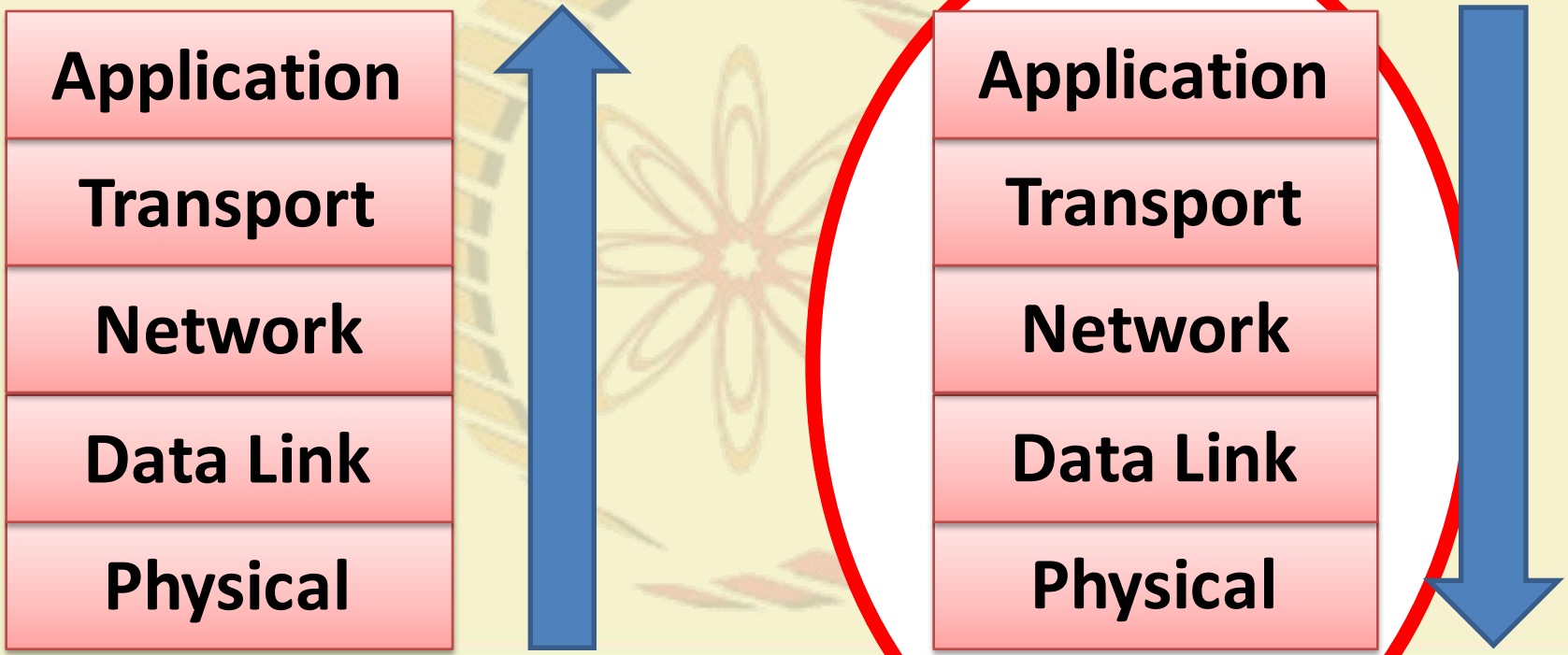
SNMP

IPv4, IPv6, MPLS

ARP, DHCP

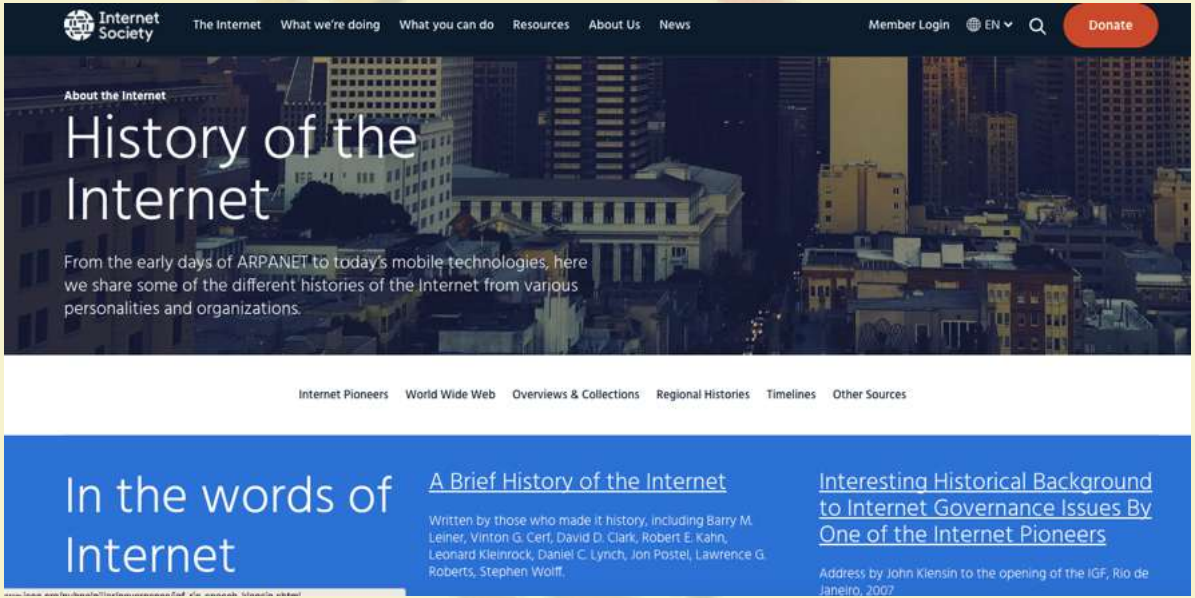
Ethernet, WiFi, Bluetooth, UMTS, LTE

Two Ways to Learn Computer Networks



History of Computer Networks

- https://www.youtube.com/watch?v=9hlQjrMHTv4



https://www.internetsociety.org/internet/history-internet

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Some Facts

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Books / Resources to Follow …

- Application
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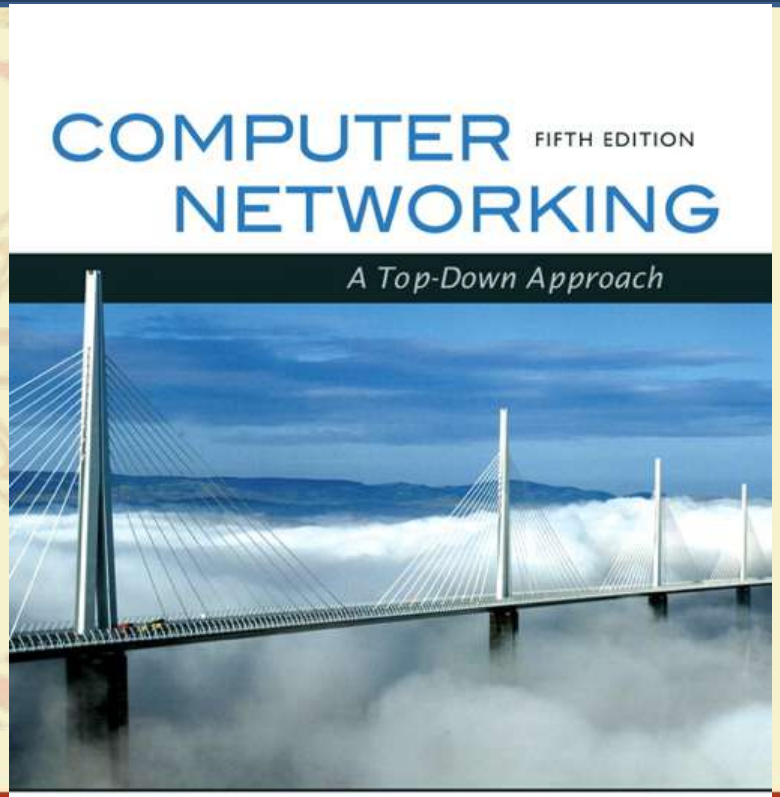

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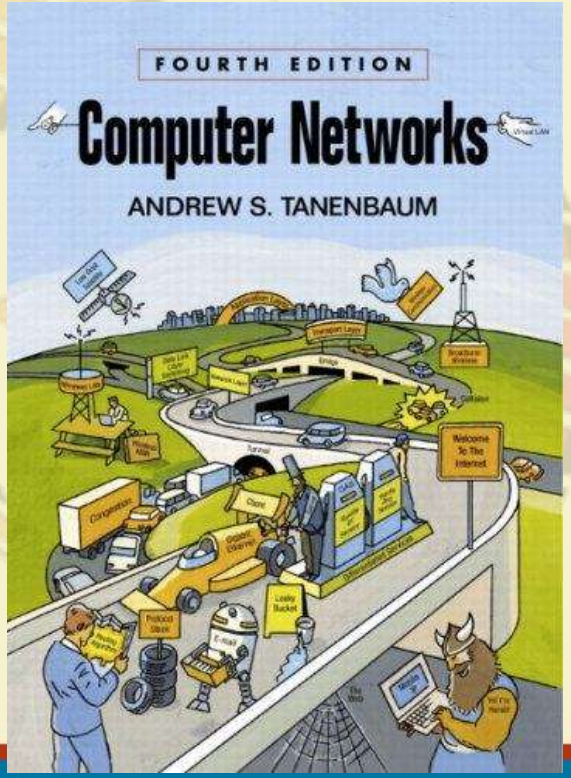

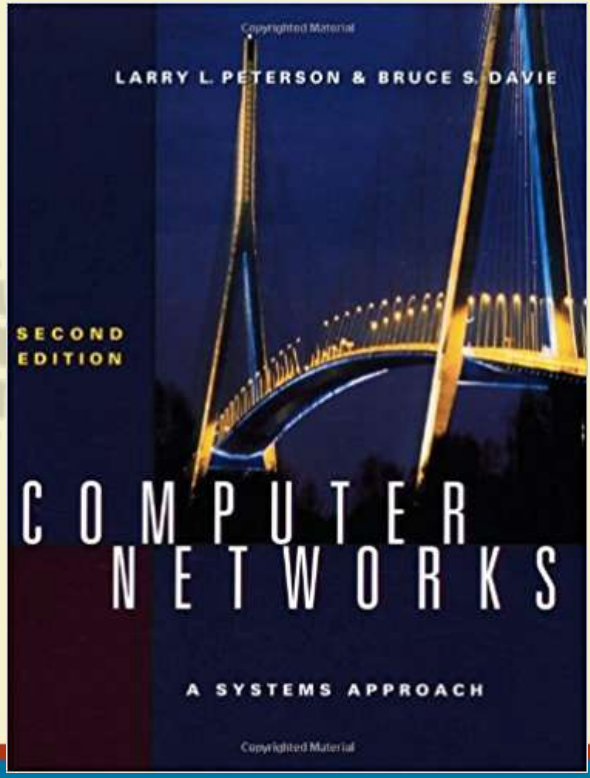

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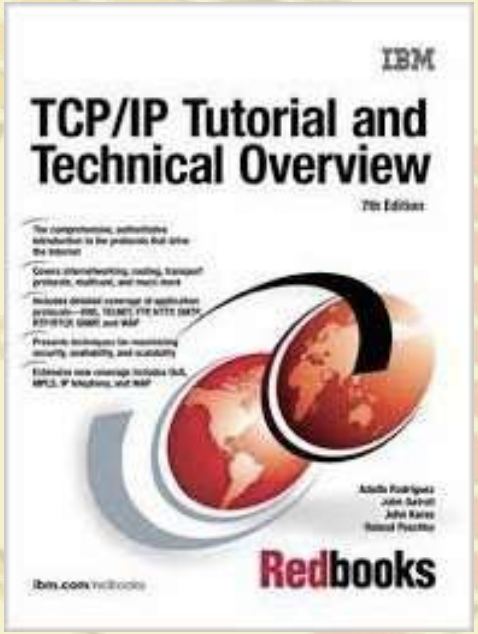

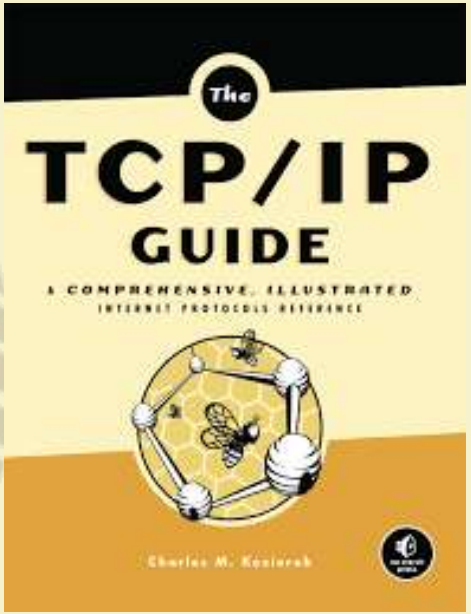

http://www.redbooks.ibm.com/abstracts/gg243376.html
http://www.tcpipguide.com/

Internet Resources

The Internet Engineering Task Force (IETF®)

The goal of the IETF is to make the Internet work better.

The mission of the IETF is to make the Internet work better by producing high quality, relevant technical documents that influence the way people design, use, and manage the Internet. Newcomers to the IETF should start here.

News

- IETF 104 in Prague!
- IETF Blog
- IETF Daily Dose

Next Meeting: IETF 101 London

IETF 101 - March 17-23, 2018

- Register
- Important Dates
- Wiki
- Agenda
- Meeting Materials
- Remote Participation
- Hackathon (open to public)

Recent Meeting: IETF 100 - Singapore

- IETF 100 Information
- IETF 100 Proceedings

Internet-Drafts and RFCs Quick Search

Search

Request for Comments (RFC)

Memos in the **Requests for Comments (RFC)** document series contain technical and organizational notes about the Internet. They cover many aspects of computer networking, including protocols, procedures, programs, and concepts, as well as meeting notes, opinions, and sometimes humor. Below are links to RFCs, as available from ietf.org and from rfc-editor.org. Note that there is a brief time period when the two sites will be out of sync. When in doubt, the RFC Editor site is the authoritative source page.

RFCs associated with an active IETF Working Group can also be accessed from the Working Group's web page via IETF Working Groups.

IETF Repository Retrieval

- Advanced search options are available at IETF Datatracker and the RFC Search Page.
- A text index of RFCs is available on the IETF web site here: RFC Index (Text).
- To go directly to a text version of an RFC, type *https://www.ietf.org/rfc/rfcNNNN.txt* into the location field of your browser, where NNNN is the RFC number.

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- RFC Search Page
- RFC Index (HTML | TXT | XML)
- Additional listings of RFCs
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RFC Errata

Published RFCs never change. Although every published RFC has been submitted to careful proofreading by the RFC Editor


thank you!

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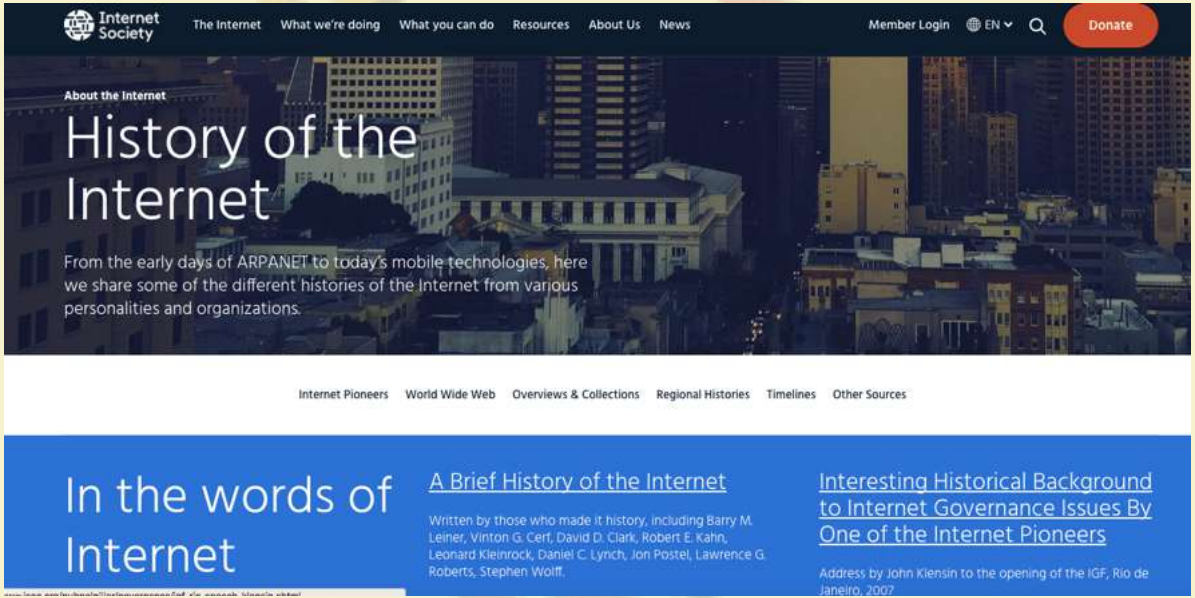

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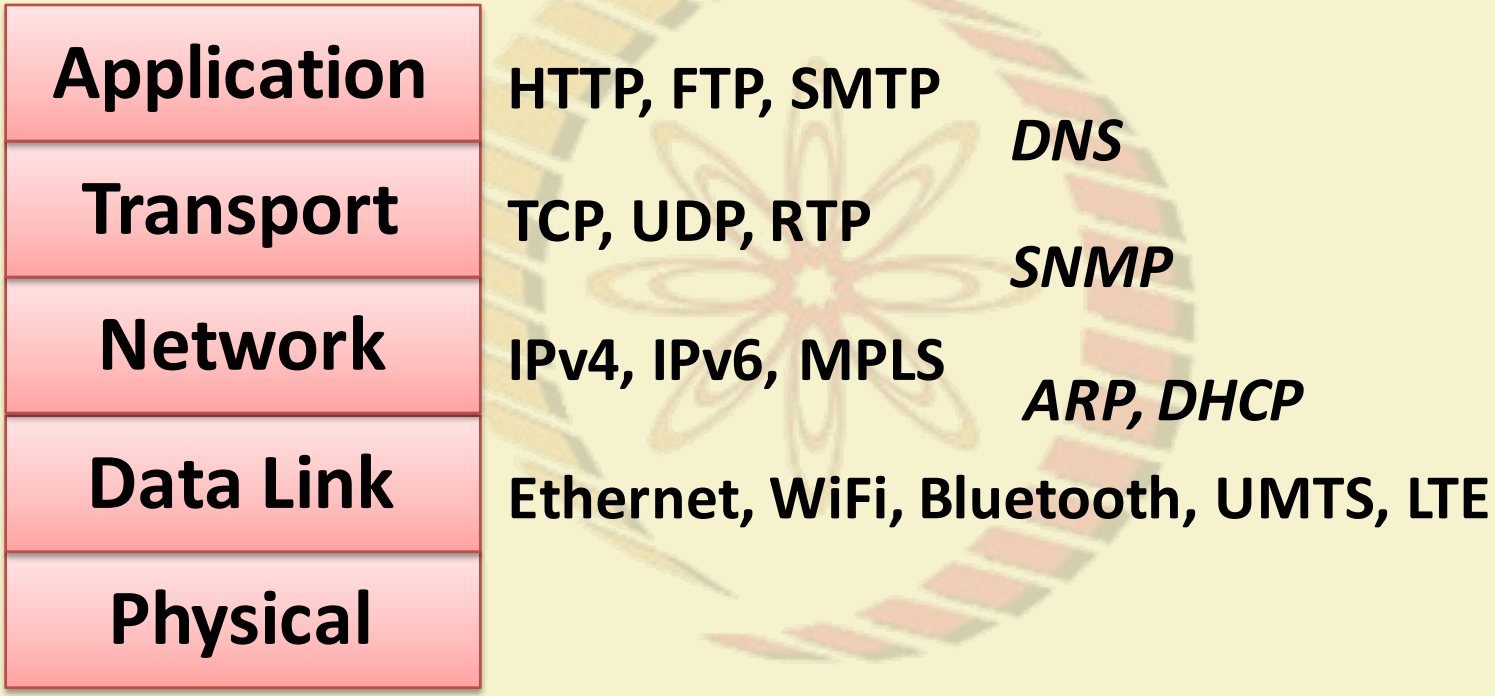
Network Management and Control – Cross Layer Protocols



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Protocols

- Protocol is a controlled sequence of messages that is exchanged between two or more systems to accomplish a given task.
- Protocol specifications define this sequence together with the format or layout of the messages that are exchanged.

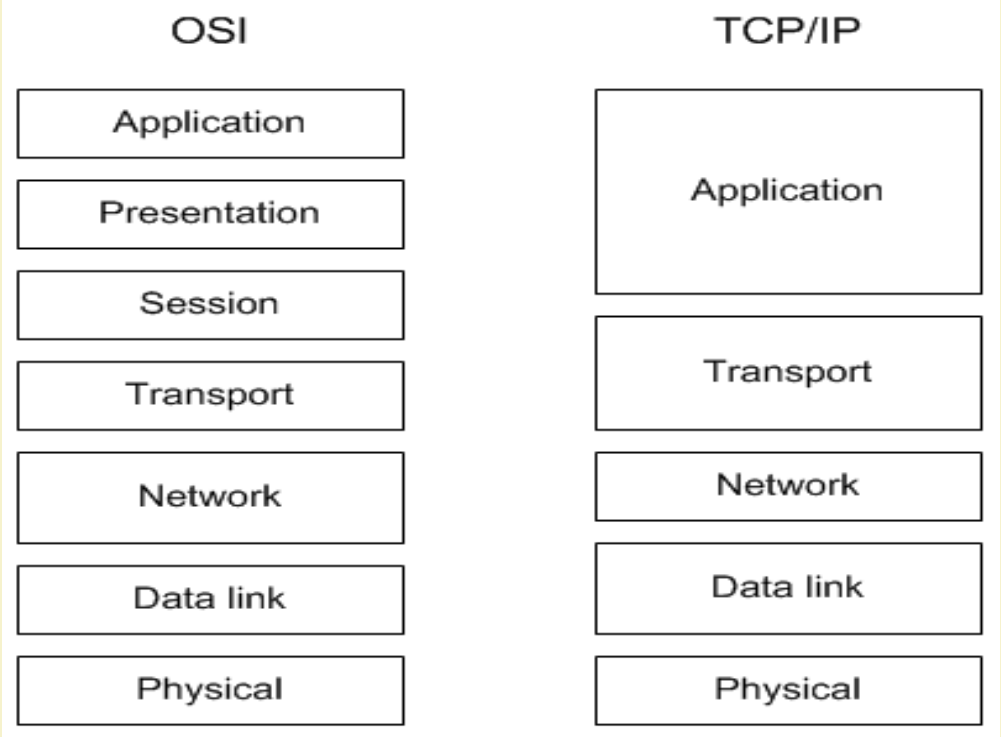
OSI Model Layers

OSI layer	Function provided
Application	Network applications such as file transfer and terminal emulation
Presentation	Data formatting and encryption
Session	Establishment and maintenance of sessions
Transport	Provision for end-to-end reliable and unreliable delivery
Network	Delivery of packets of information, which includes routing
Data Link	Transfer of units of information, framing, and error checking
Physical	Transmission of binary data of a medium

Transmission Control Protocol / Internet Protocol (TCP/IP)

- Transmission Control Protocol/Internet Protocol (TCP/IP) suite of protocols has become the dominant standard for inter-networking.
- TCP/IP represents a set of public standards that specify how packets of information are exchanged between computers over one or more networks.

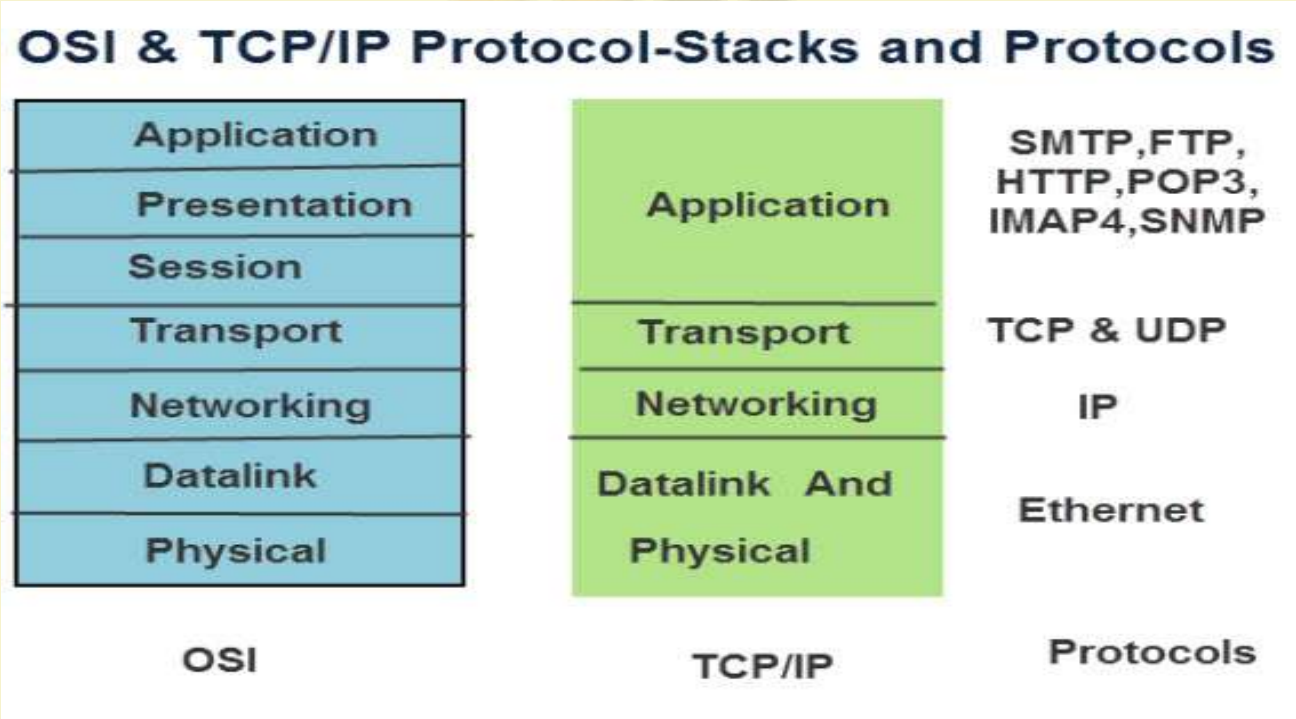
OSI and TCP/IP



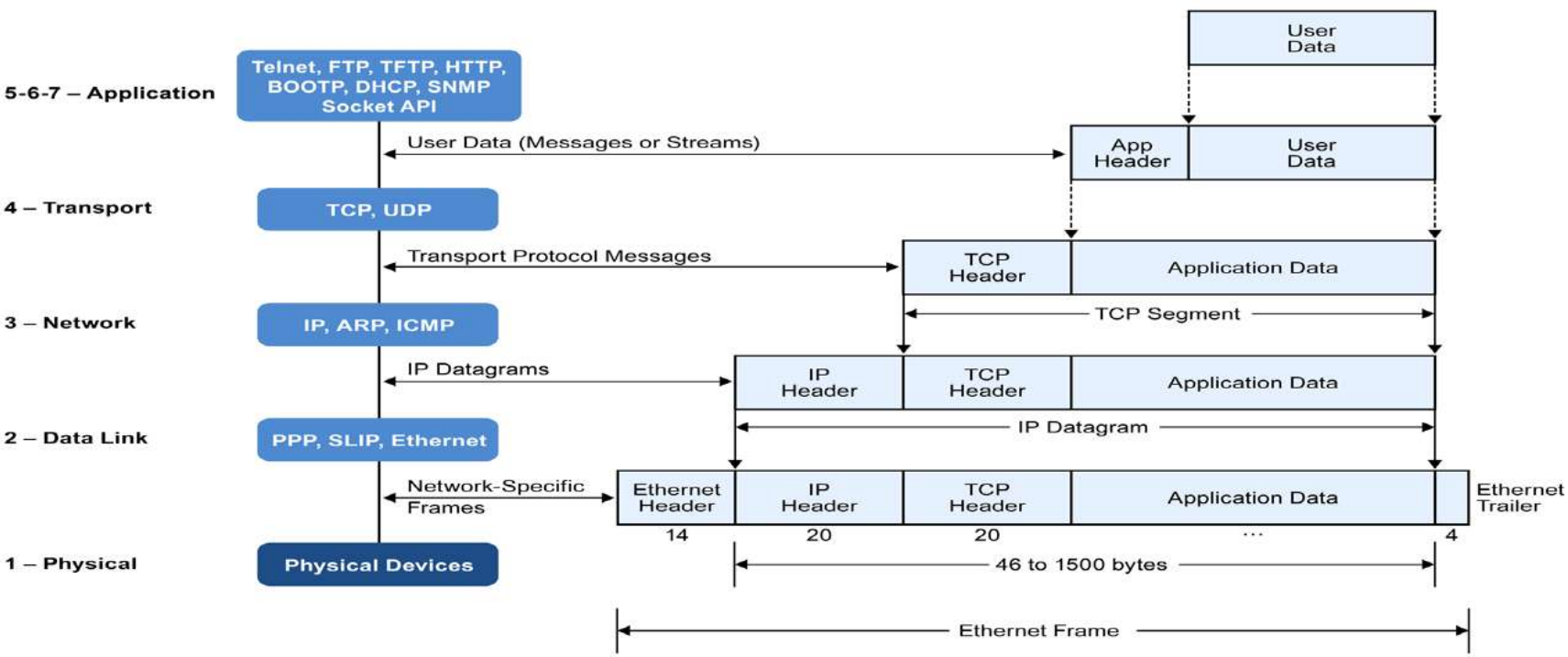
TCP/IP

Application (Host To Host Layer)	Ping	Telenet & Rlogin	FTP	SMTP	SNMP	Trace-route
	DNS	TFTP	BOOTP	RIP	OSPF	etc.
Transport	TCP		UDP		ICMP	
Network	IP					
Data Link	LLC		HDLC		PPP	
	Ethernet	802.3	X.25	Token Ring	Frame Relay	ATM	SMDS	etc.
Physical	Fiber Optics		UTP	Coax	Microwave	Satellite	STP	

OSI and TCP/IP



TCP/IP – Packet Encapsulation



Local Area Network (LAN) – Typical Components

- Clients – workstations
- Servers – usually have more computing resources
- Network devices
  - Repeaters
  - Hubs
  - Transceivers
  - NICs
  - Bridges
  - Switches
  - Routers

Wide Area Networks

- A WAN is a data communications network covering a large geographic area.
- Unlike LANs , a WAN connection is generally rented from a *service provider*.
- WANs connect various sites at different geographic locations so that information can be exchanged.

Evolution of LAN Devices

- NICs, Repeaters, & Hubs
- Bridges
- Switches
- Routers

NIC Specifics

- NICs provide hosts with access to media by using a MAC address.
- MAC stands for Media Access Control
- NICs operate at Layer 2 !!

NICs, Repeaters, & Hubs

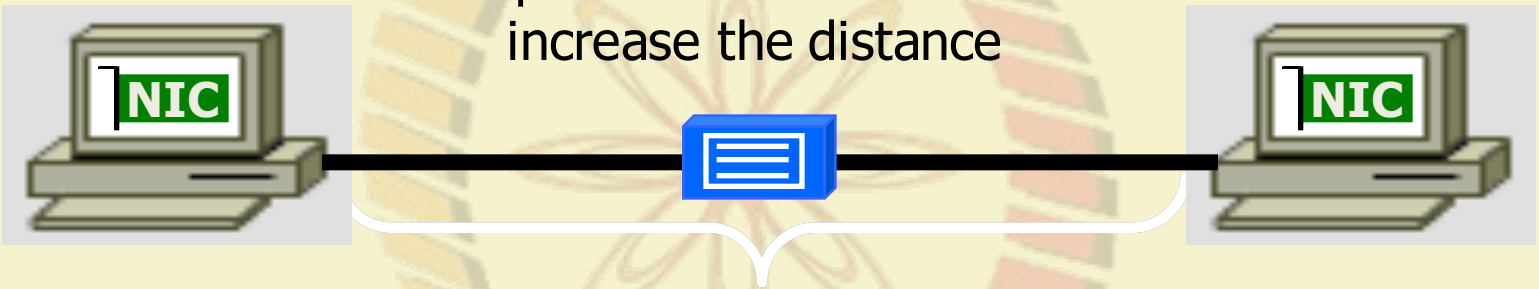
To connect two computers, you must...

- Install a NIC card in each.

Attach computers using a crossover cable

NICs, Repeaters, & Hubs

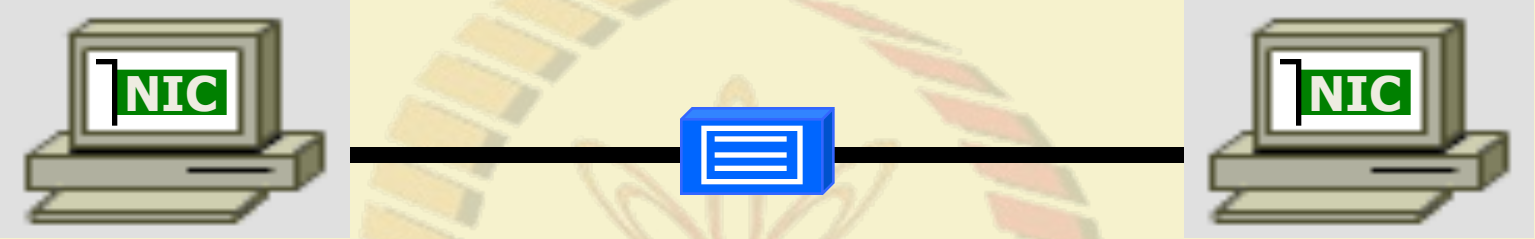
Repeaters can be used to increase the distance



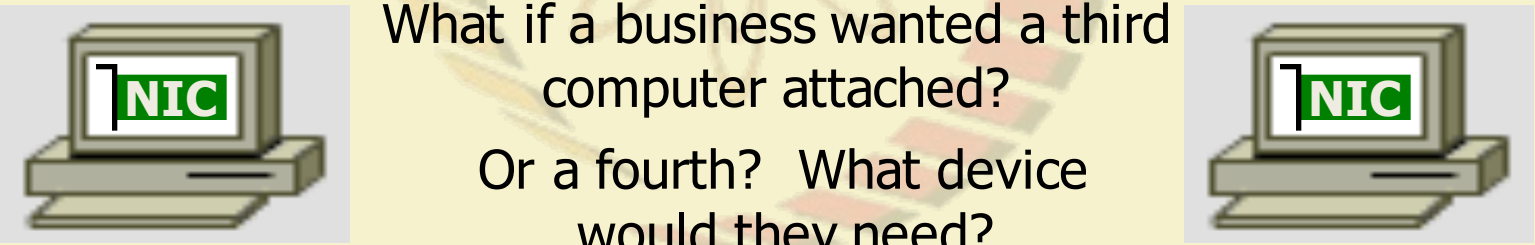
100 meters or approx. 300 feet

Repeaters amplify and retime signals

NICs, Repeaters, & Hubs



Using repeaters was fine as long as a business only needed <u>two</u> computers networked.

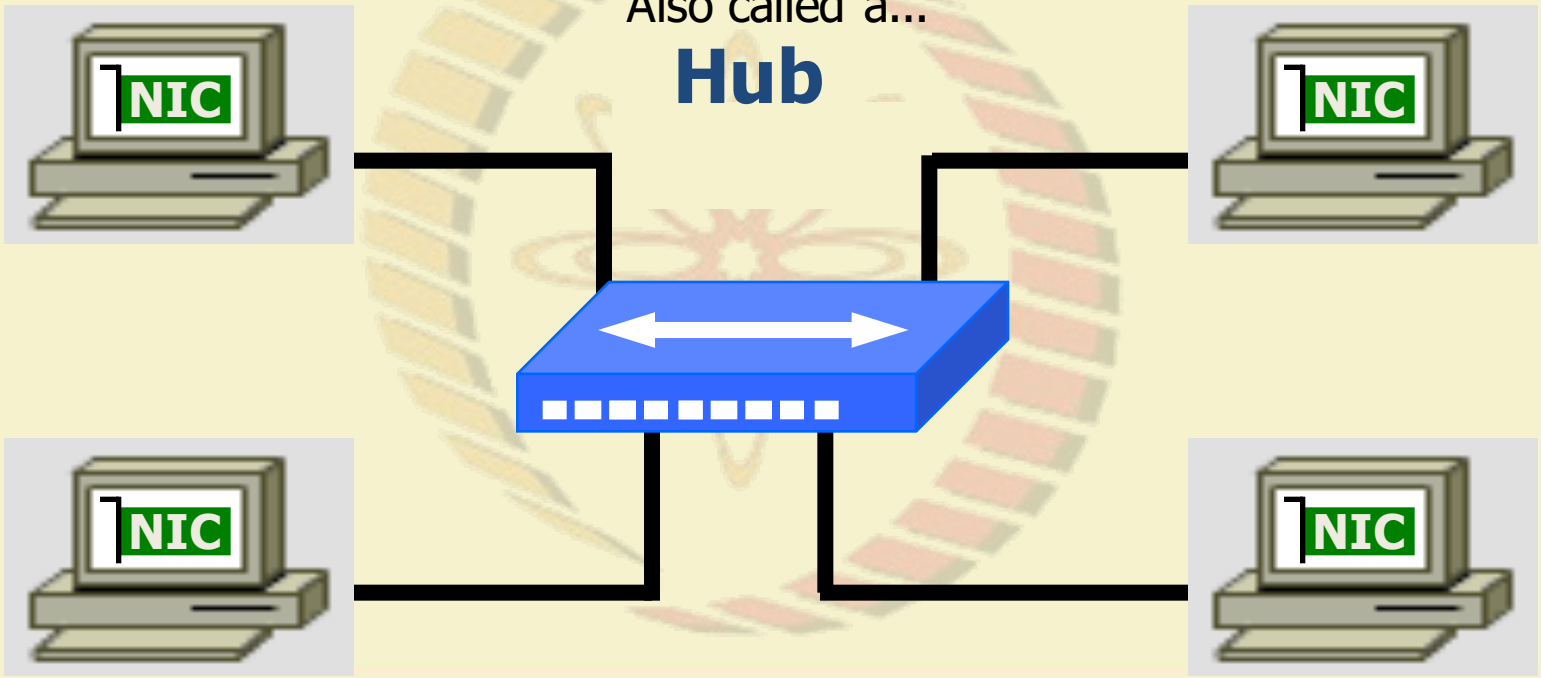


What if a business wanted a third computer attached?

Or a fourth? What device would they need?

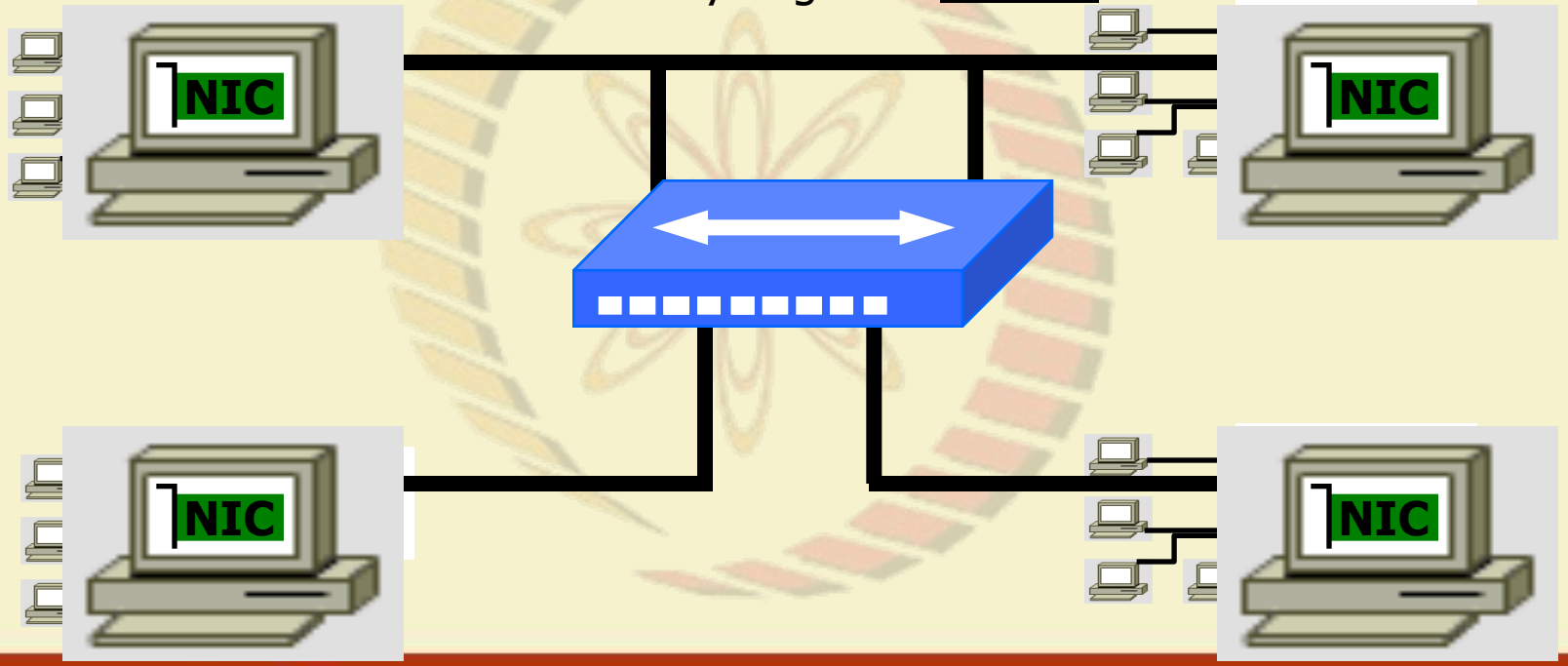
NICs, Repeaters, & Hubs

A multi-port repeater!
Also called a...
Hub



A Dilemma!

As businesses expanded their networks, they began to cascade hubs.



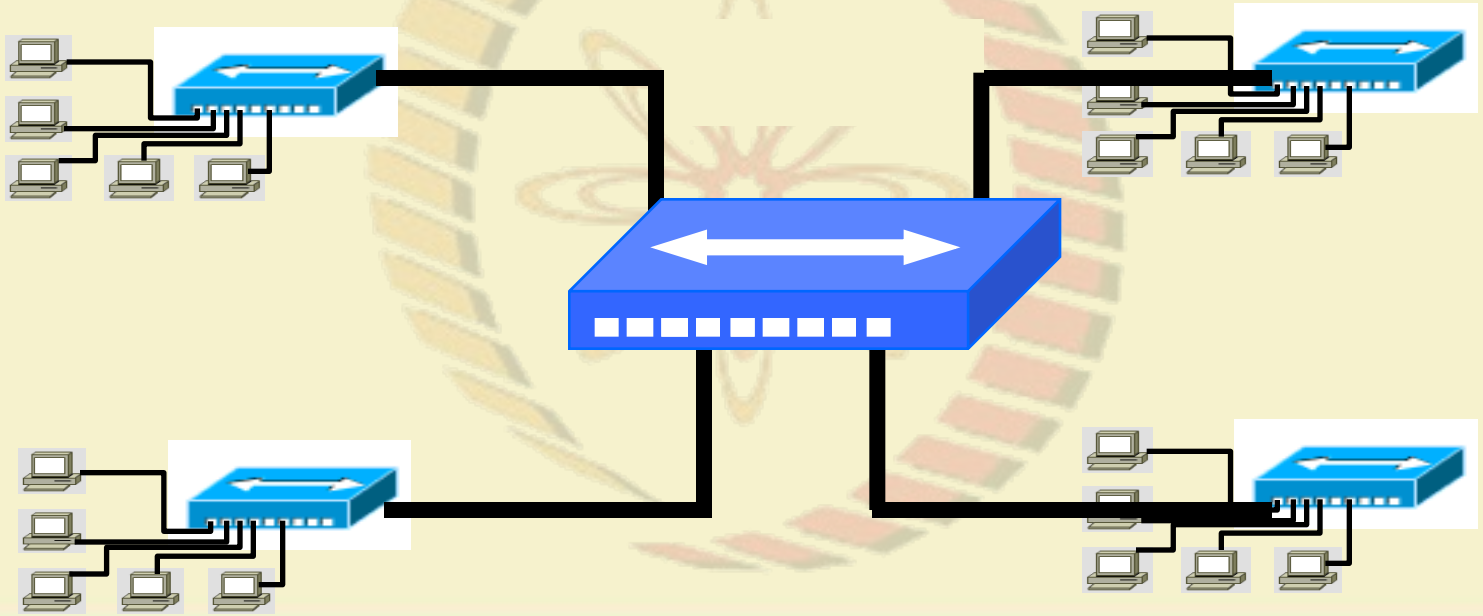
What's The Problem?

1) Hubs share bandwidth between all attached devices.
2) Hubs are stupid, Layer 1 devices. They cannot filter traffic.
3) Most LANs use a "broadcast topology," so every device sees every packet sent down the media.

Let's take a look at how broadcasting works

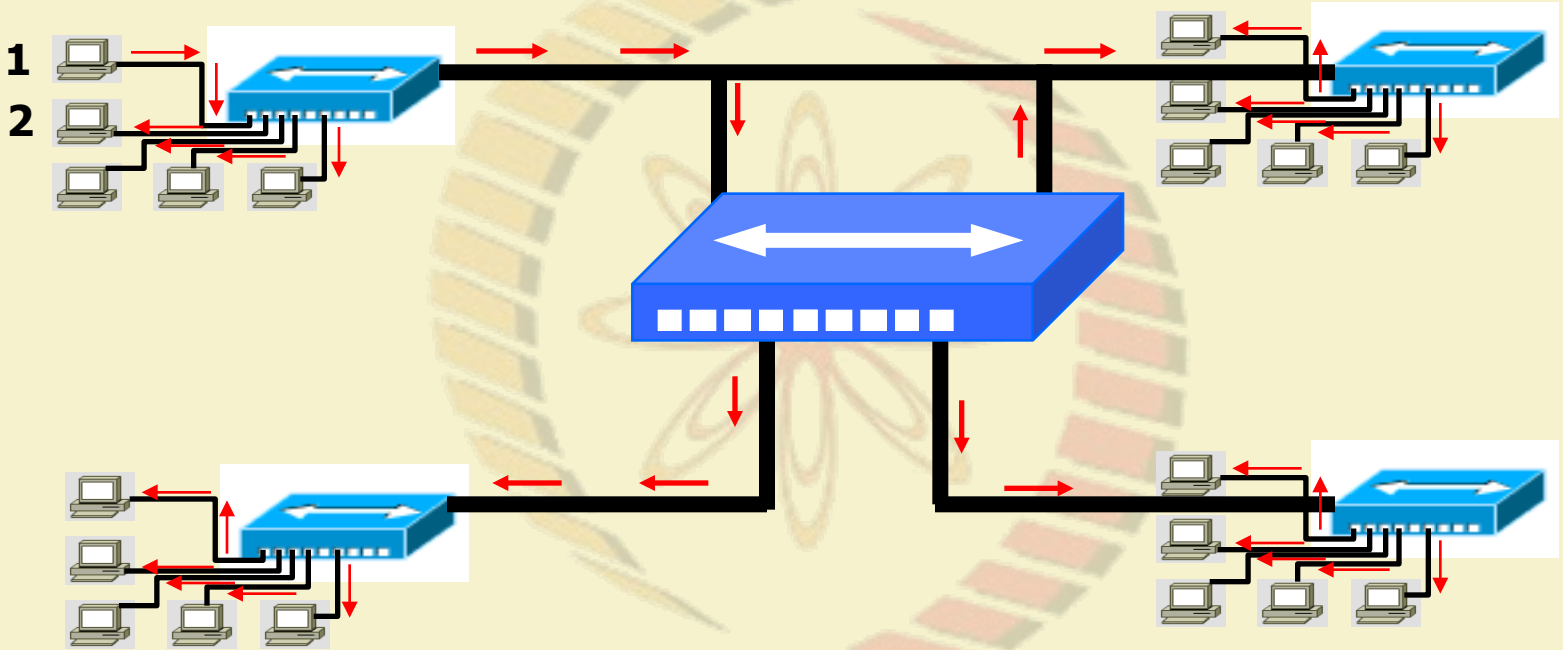
Broadcasts

In this picture, all hubs forward all traffic to all devices.



Broadcasts

So, if Host 1 wants ping Host 2, all hosts see the ping. This is what we mean by a broadcast topology



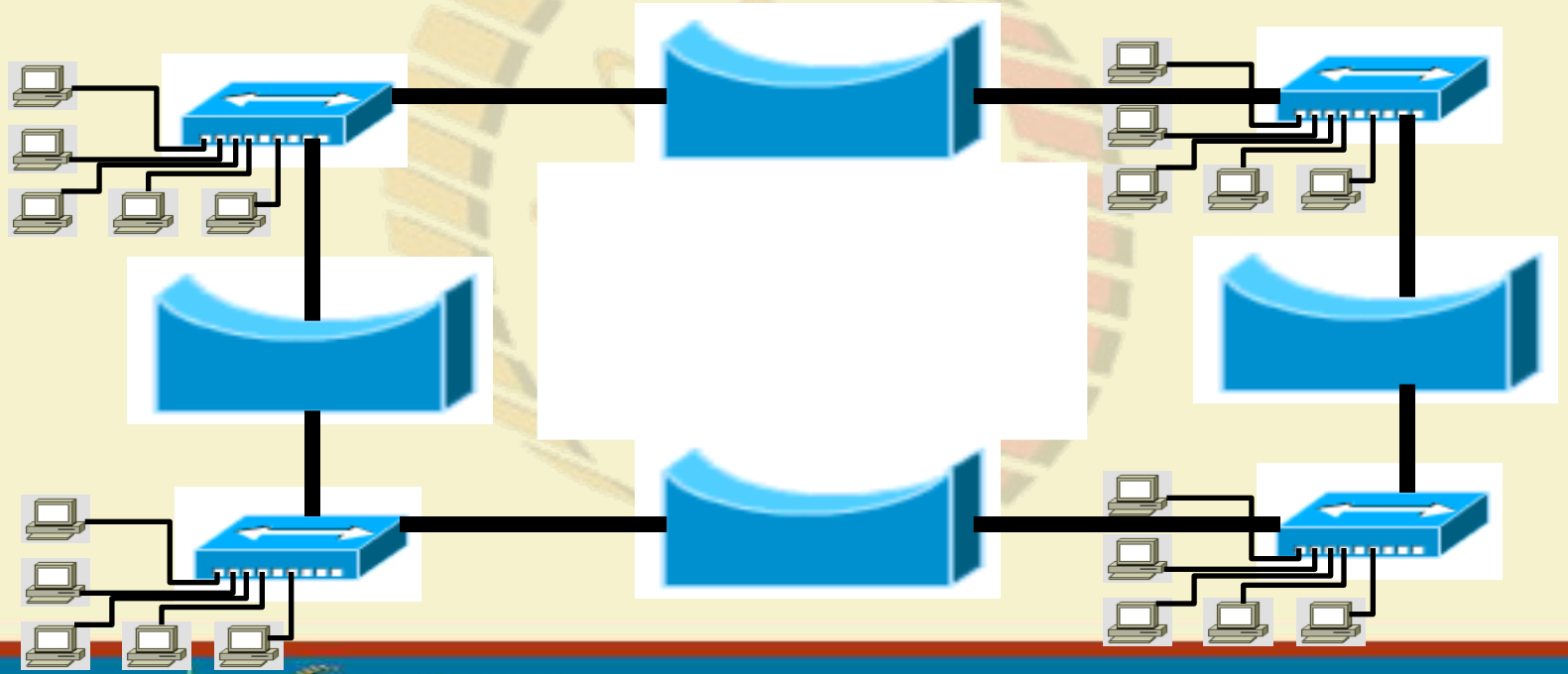
The red arrows show that all hosts receive the ping request. Only Host 2 will respond.

What's The Solution?

- We need a smarter hub!
- What's a "smarter hub" called?
- A Bridge!
- Bridges filter network traffic based on MAC addresses.
- Let's take a look at how this works.

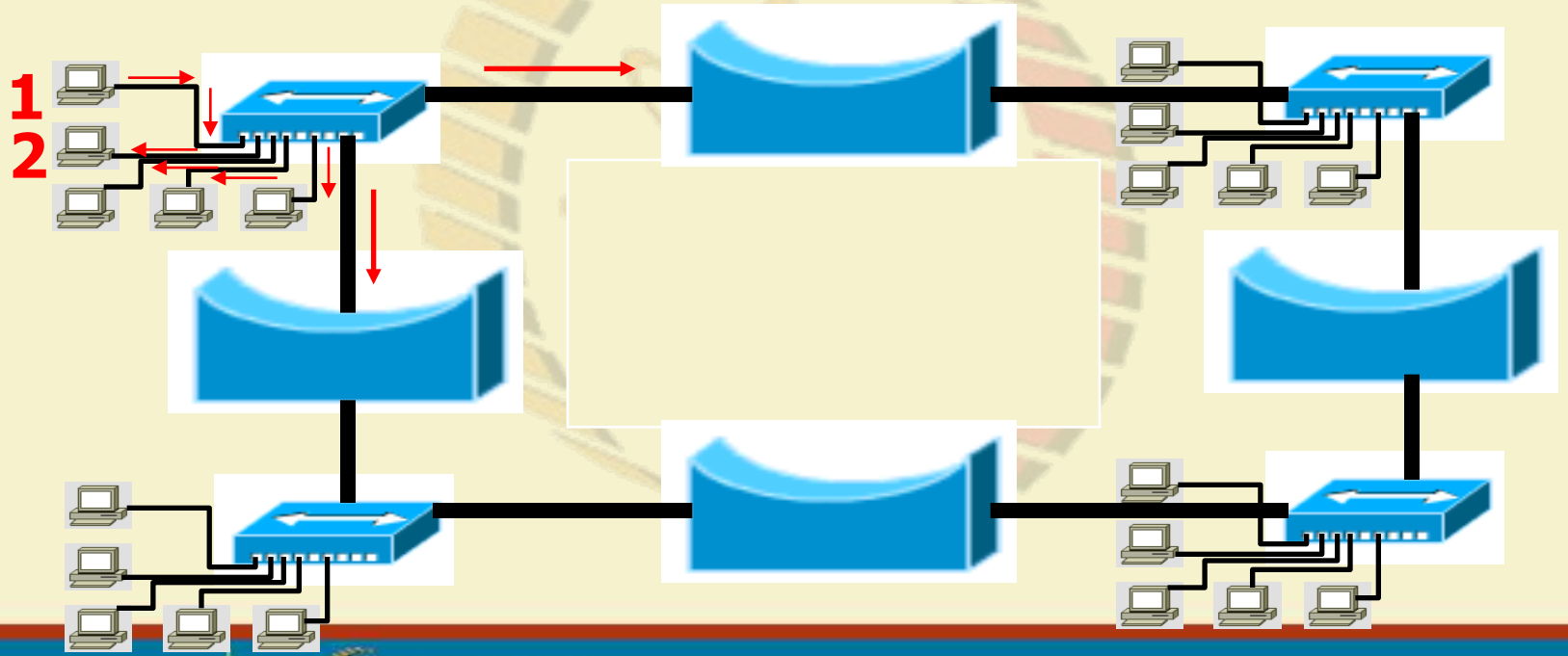
Bridge

To lessen the amount of LAN traffic, businesses began to uses bridges to filter frames based on MAC addresses.



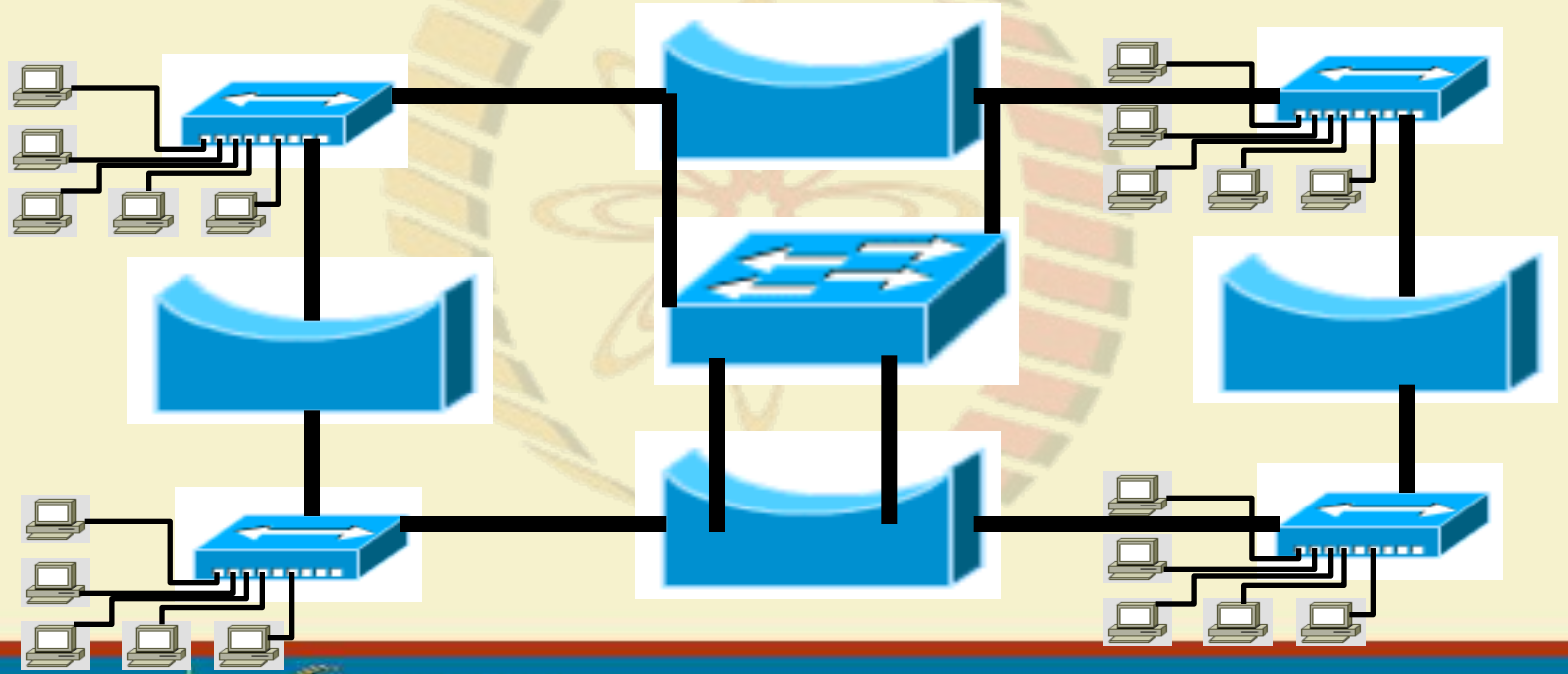
Bridge

Now, if Host 1 pings Host 2, only the hosts on that LAN segment see the ping. The bridges stop the ping.



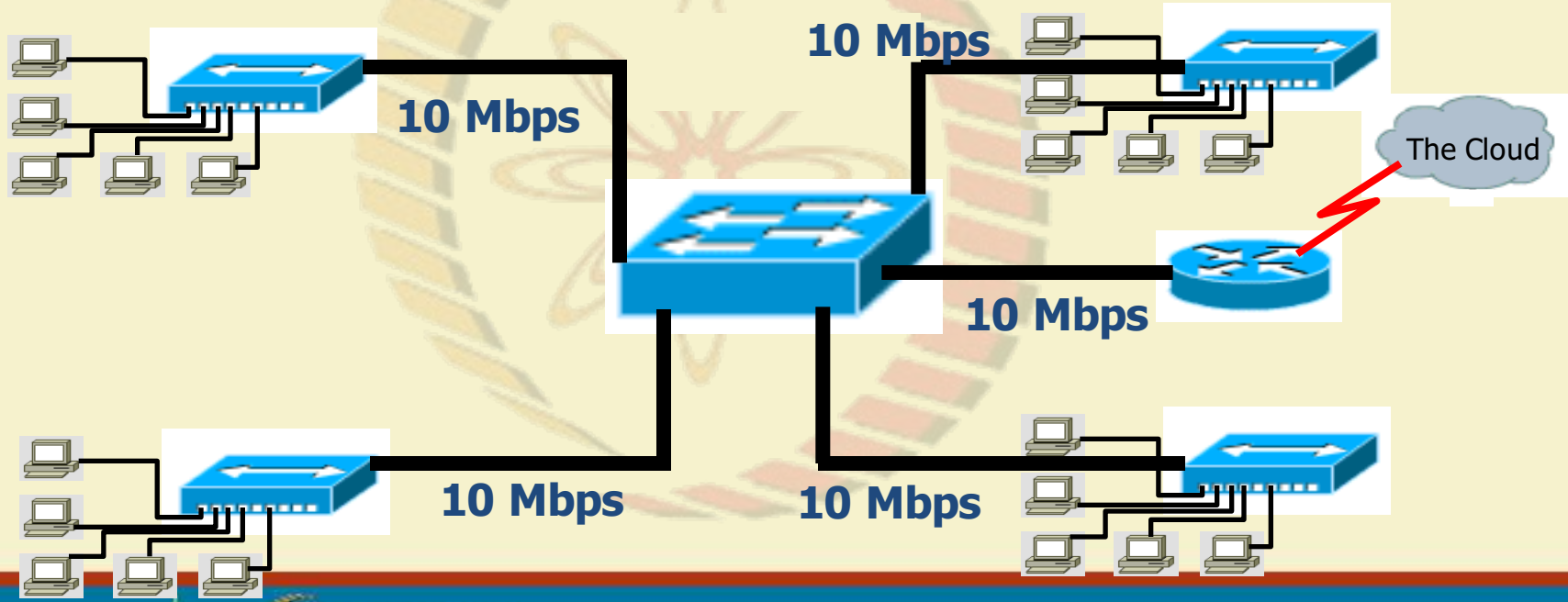
Switch

A switch (also know as a multi-port bridge), can effectively replace these four bridges.



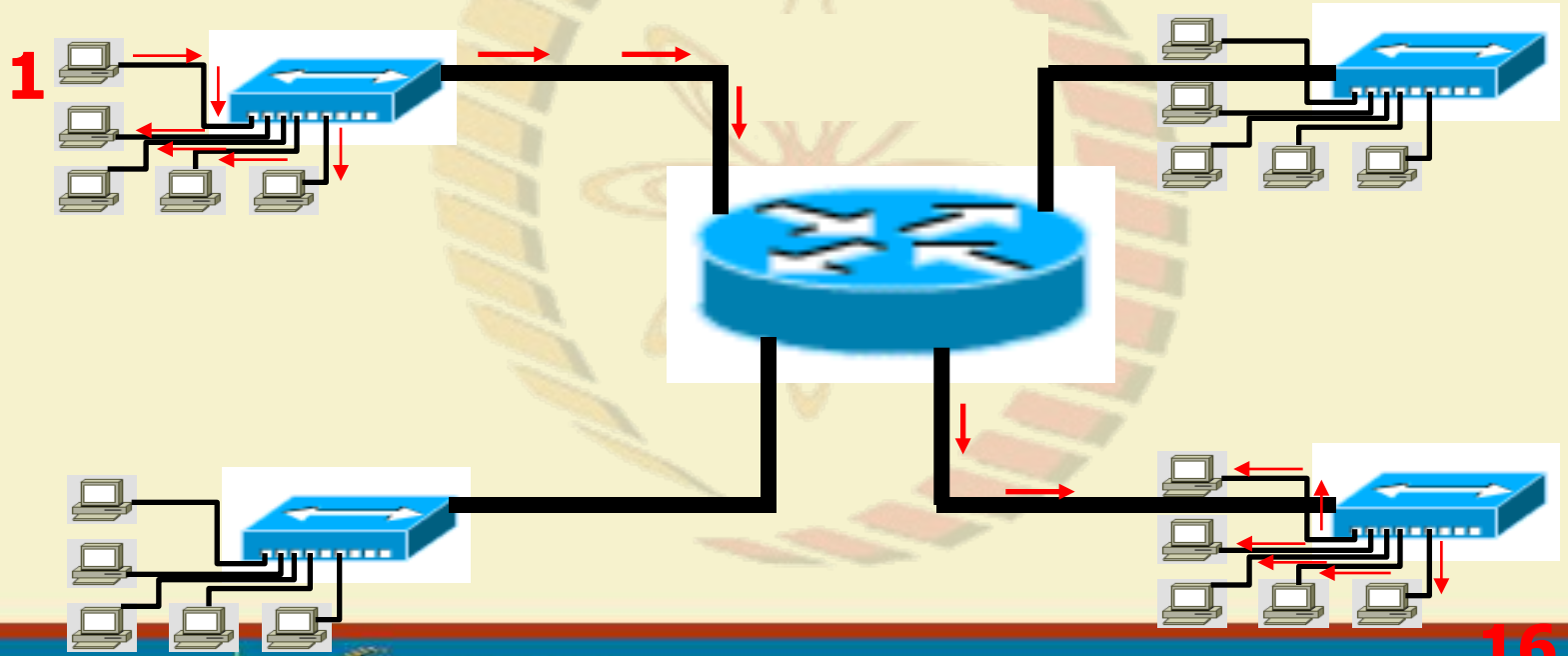
Switch

Another benefit of a switch is that each LAN segment gets dedicated bandwidth.

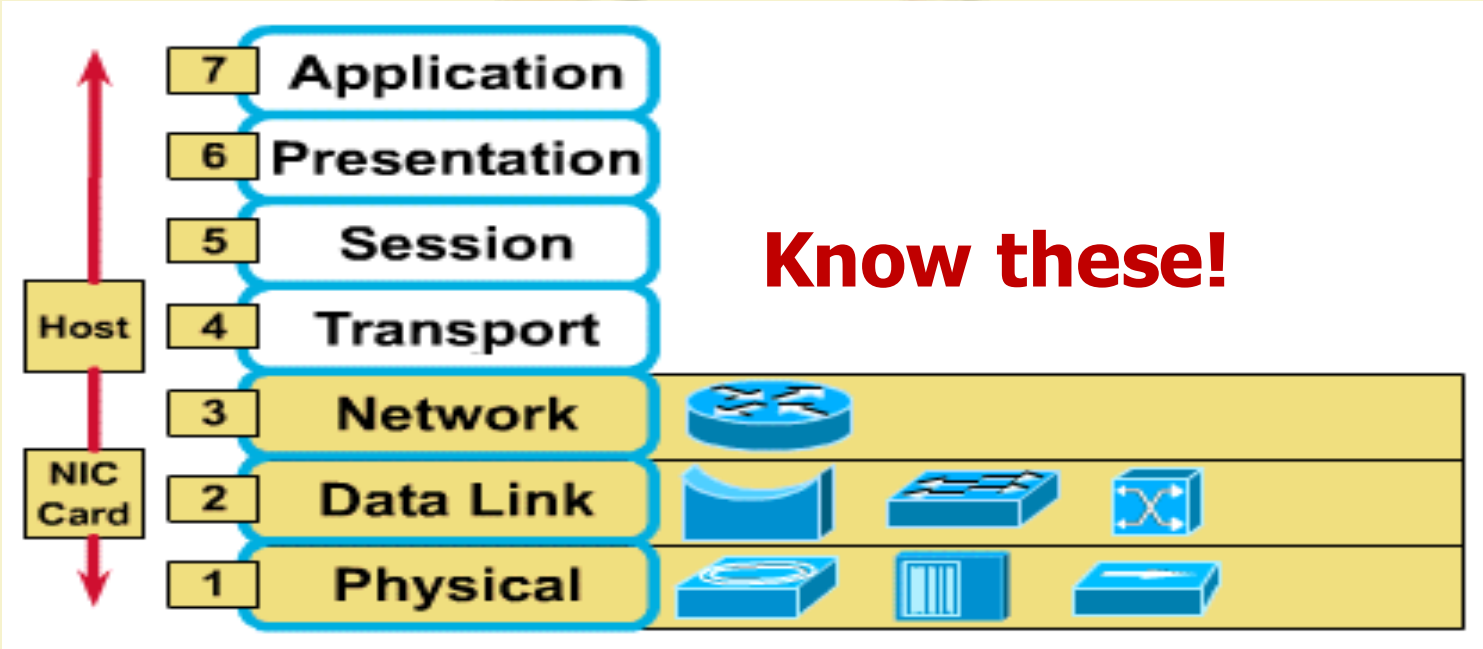


Router

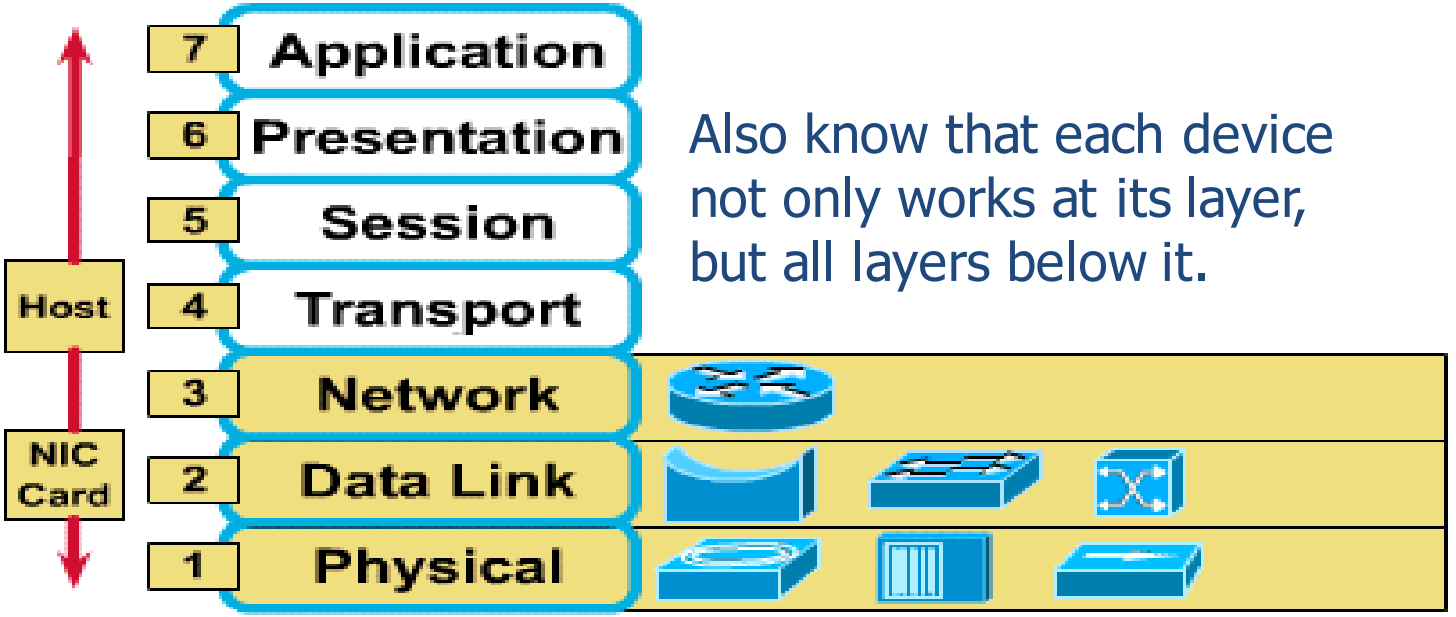
Routers filter traffic based on IP addresses. The IP address tells the router which LAN segment the ping belongs to.



Devices Function at Layers

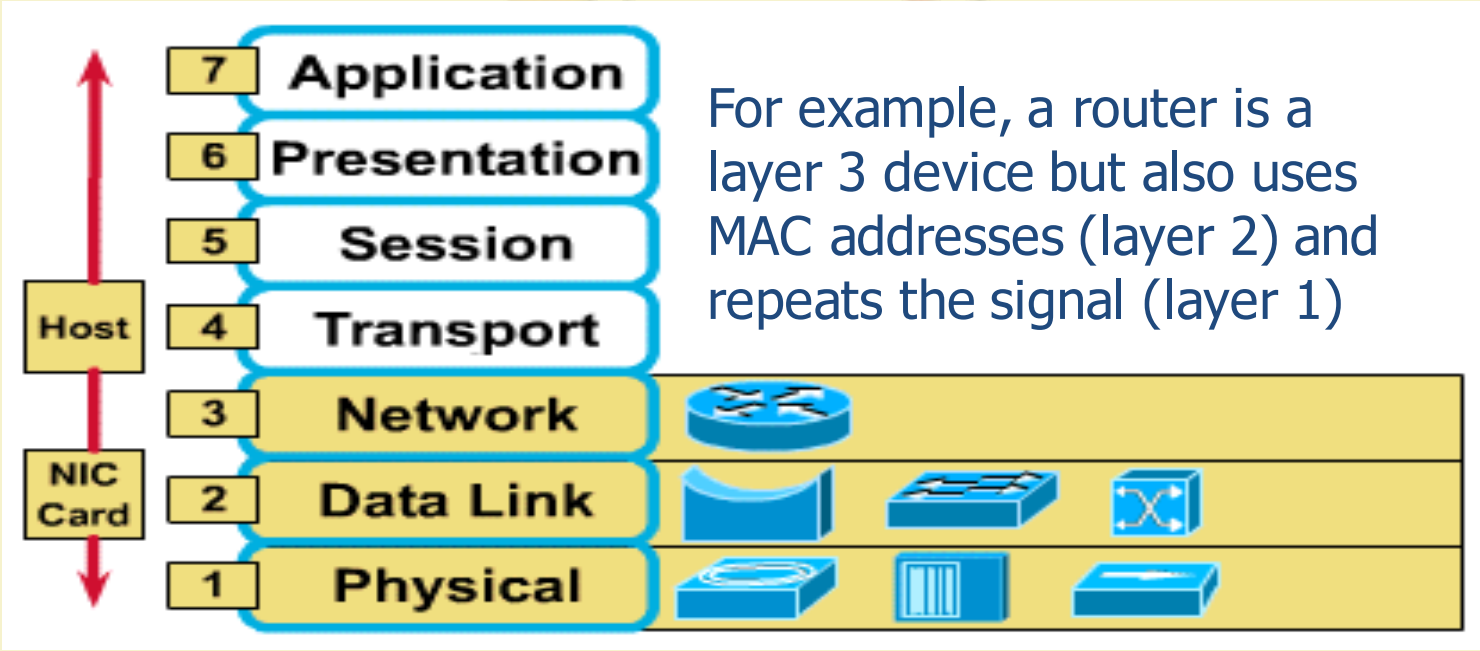


Devices Function at Layers



Also know that each device not only works at its layer, but all layers below it.

Devices Function at Layers



For example, a router is a layer 3 device but also uses MAC addresses (layer 2) and repeats the signal (layer 1)

Hierarchical Design Model

- A layered model for network design
- Consists of 3 tiers
- Access layer - for end user connectivity
- Distribution layer - for policy based routing and access control
- Core layer- for switching packets as fast as possible across the *internetwork*.

Few points to note ….

- Routers, by default, break up *broadcast domain*
- Broadcast domain – Set of all devices on a network segment that hear all the broadcasts sent on that segment
- Breaking-up of network broadcast is important – because when a host or server sends a network broadcast, every device on the network "must" read and process that broadcast.
- When a router's interface receives this broadcast – it discards the broadcast without forwarding it on to other network
- *Router also breaks up "collision domain" as well !*

Few points to note …. (contd)

- Switches aren't used to create internetworks, they're employed to add functionality to an internetwork LAN
- Switches only "switches" frames from one port to other within a "switched network"
- Switches break-up *collision domains*.
- Collision domain – Ethernet term ! – used to describe a network scenario in which one particular device sends a packet on a network segment, forcing other devices on the same segment to pay attention to it. At the same time, a different device tries to transmit, leading to collision, then both the devices must re-transmit – a situation found in a Hub
- Each and every port on a switch represent its own collision domain (*Hub represents only one collision domain and only one broadcast domain*)


thank you!

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CERTIFICATION COURSES

COMPUTER NETWORKS AND INTERNET PROTOCOLS

Circuit Switching and Packet Switching

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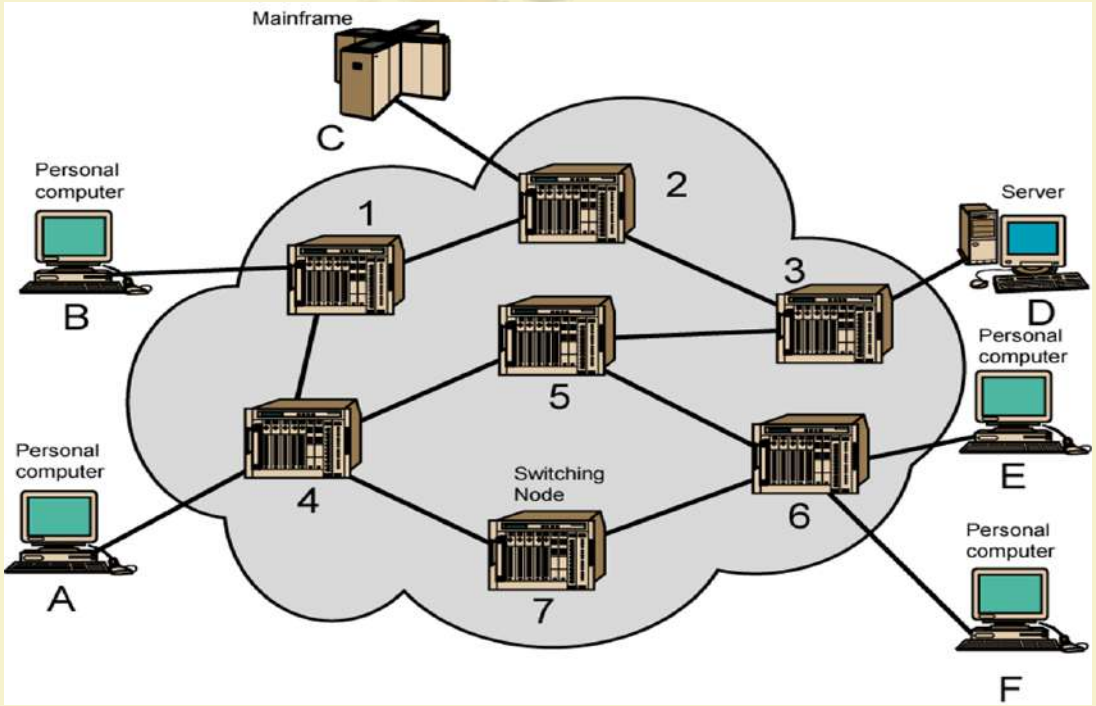
Switched Network

- Communication between distant stations/ end-devices is typically done over a network of switching nodes.
- Switching nodes do not concern with content of data. The purpose is to provide a switching facility that will communicate/transmit the data from source to destination via intermediate node(s).
- A collection of nodes and connections forms a communications network.
- In a switched communications network, data entering the network from a source station are routed to the destination by being switched from node to node.

Ref: Data & Computer Communications by William Stallings

Typical Switching Network



Ref: Data & Computer Communications by William Stallings

Switching Technologies

- Switching nodes may connect to other nodes, or to some stations.
- Network is usually partially connected
  - However, some redundant connections are desirable for reliability

- Two different switching technologies
  - Circuit switching
  - Packet switching

Ref: Data & Computer Communications by William Stallings

Circuit Switching

- Dedicated communication path between two stations
- Three phases
  - Establish
  - Transfer
  - Disconnect
- Must have switching capacity and channel capacity to establish connection
- Must have intelligence to work out routing

Ref: Data & Computer Communications by William Stallings

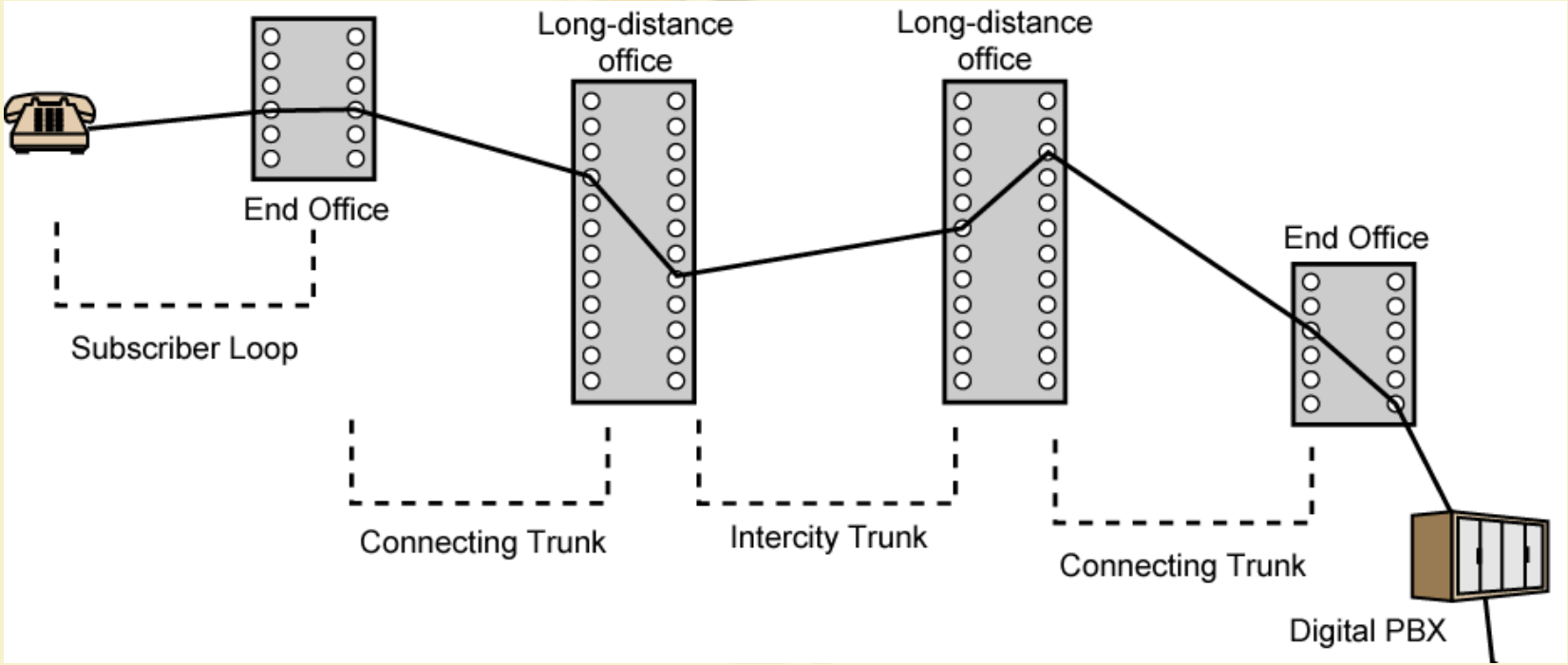
Packet Switching

- A station breaks long message into packets
- Packets are sent out to the network sequentially, one at a time
- The stream of packets are routed through the network and are delivered to the intended destination?
  - Two approaches
    - **Datagram** approach
    - **Virtual circuit** approach

Circuit Switching - Approaches

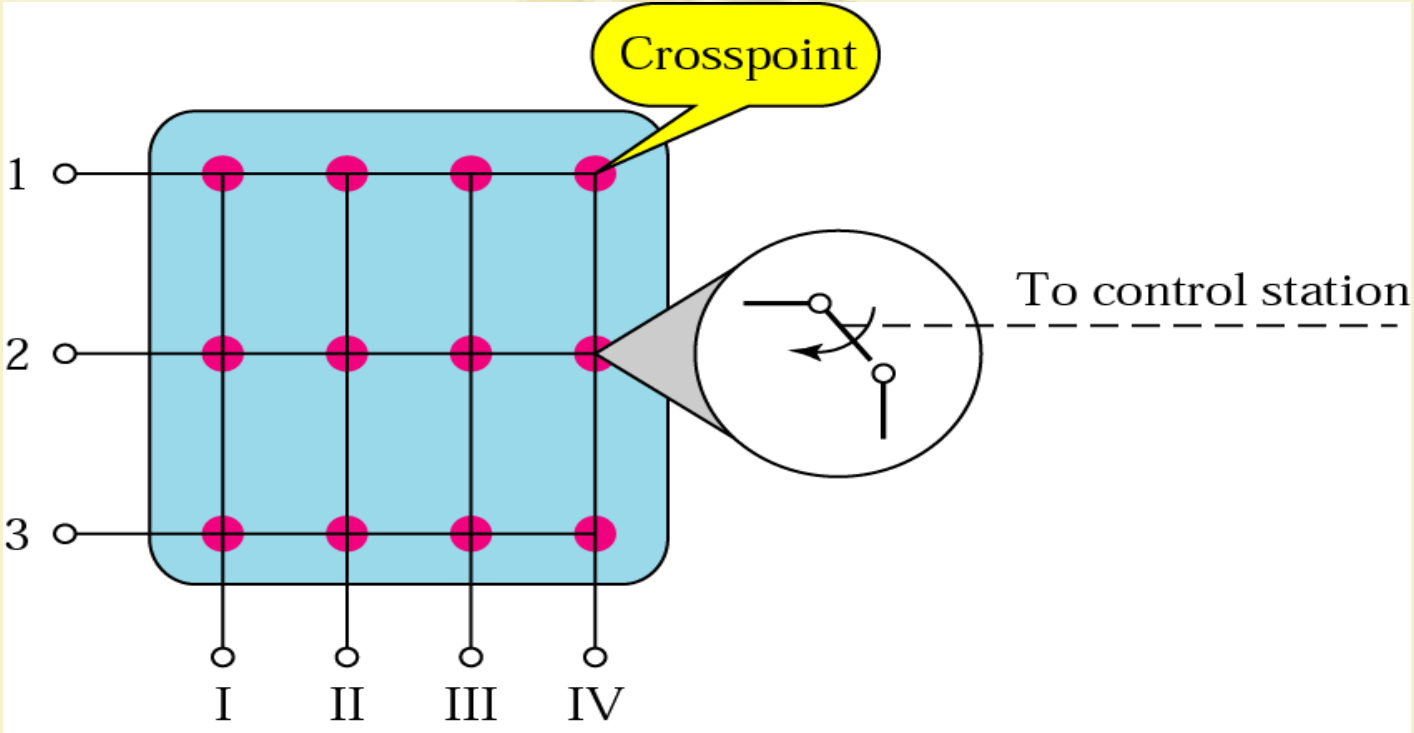
- Space-Division Switch
- Time-Division Switch
- TDM Bus
- Combinations

Circuit Switching - Approaches



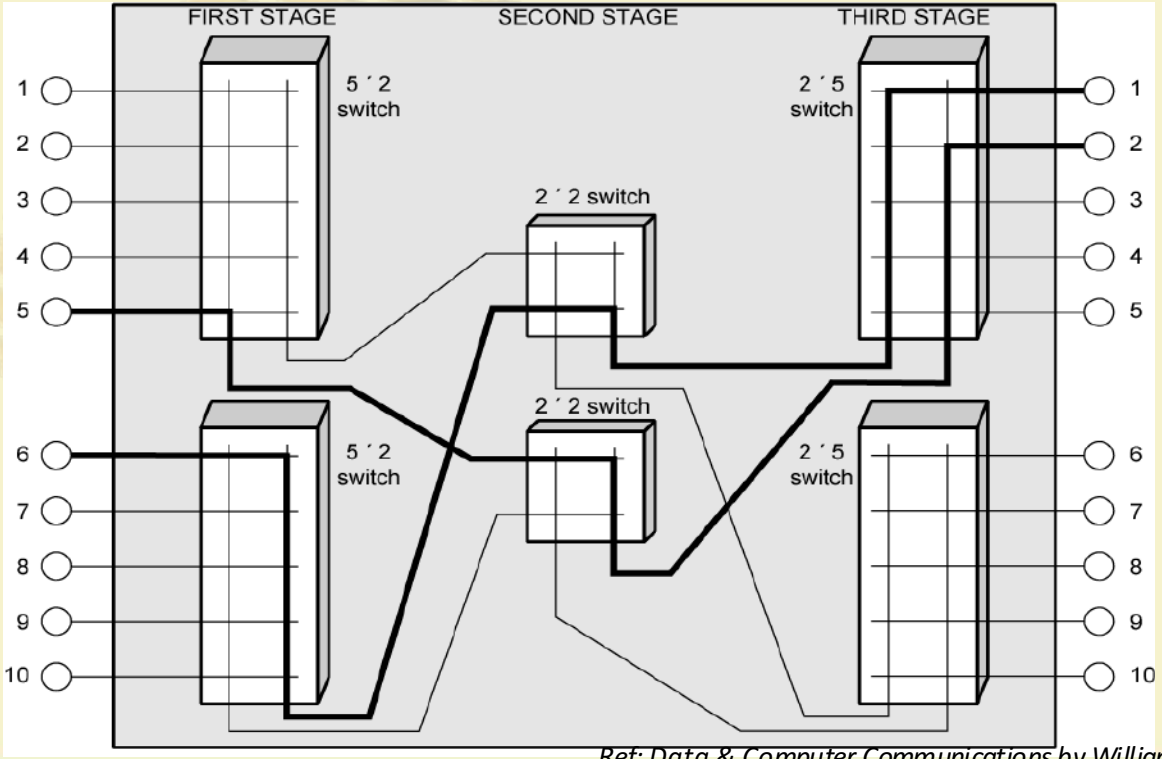
Ref: Data & Computer Communications by William Stallings

Circuit Switching – Space Division Switch



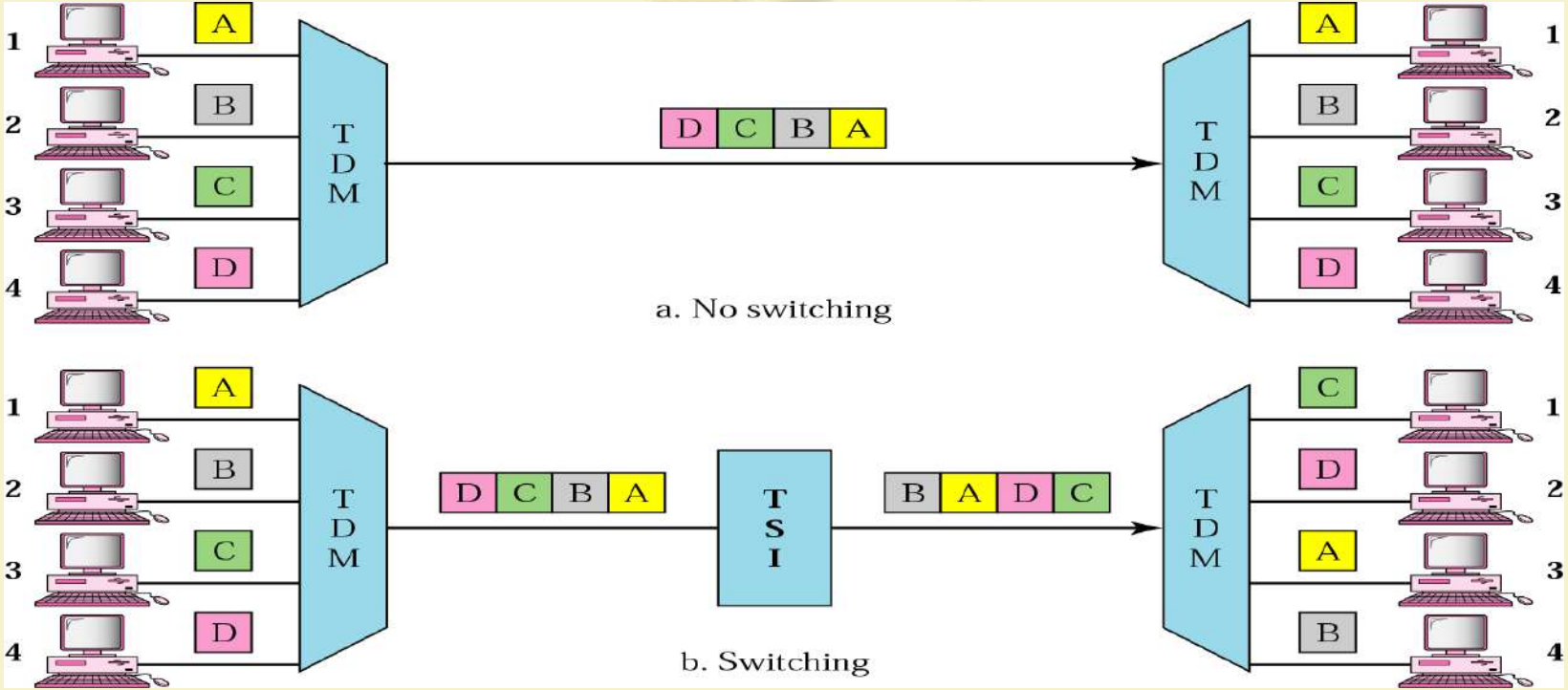
Circuit Switching – Multi-stage Space Division Switch

3-stage Space Division Switch



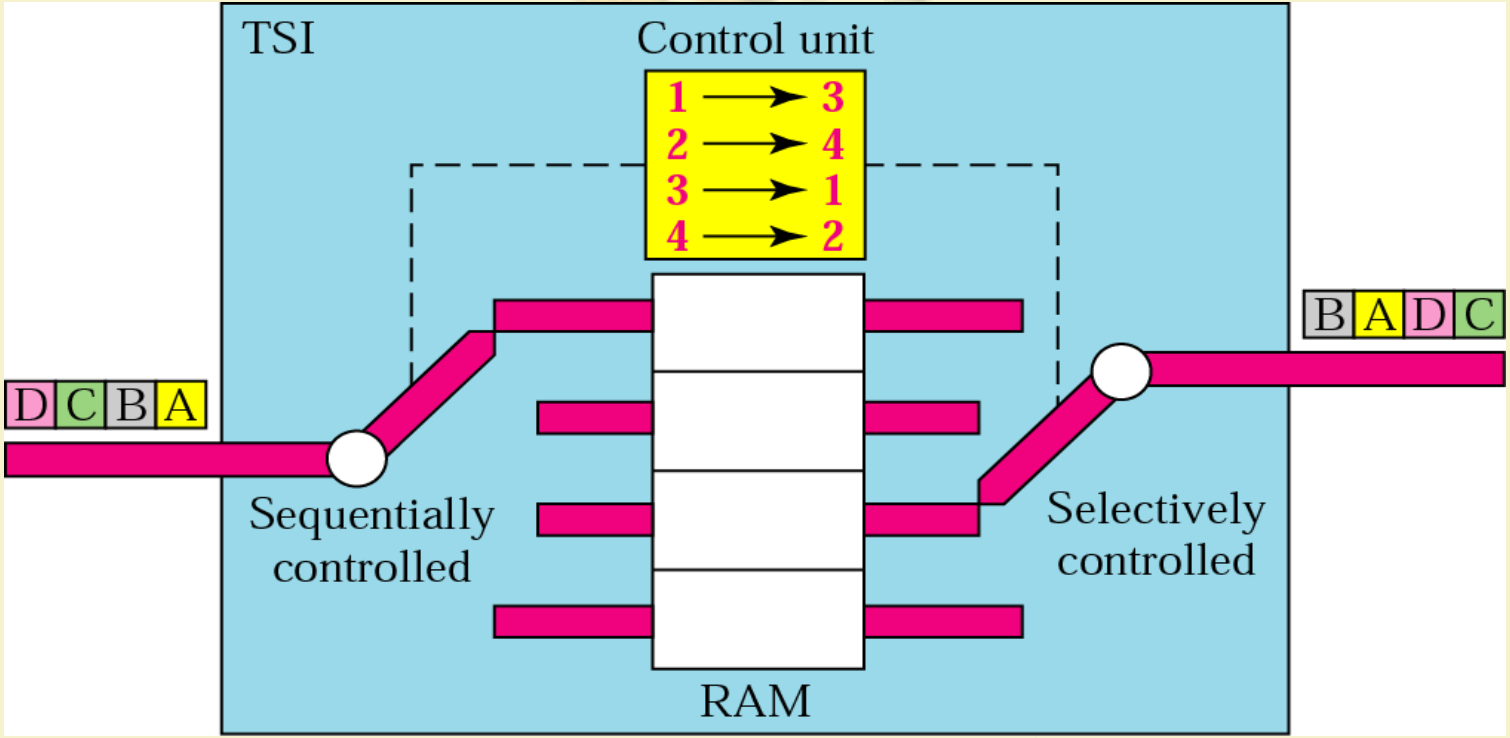
Ref: Data & Computer Communications by William Stallings

Circuit Switching – Time Division Multoplexing



Ref: Data & Computer Communications by William Stallings

Circuit Switching – Time Slot Interchange



Ref: Data & Computer Communications by William Stallings

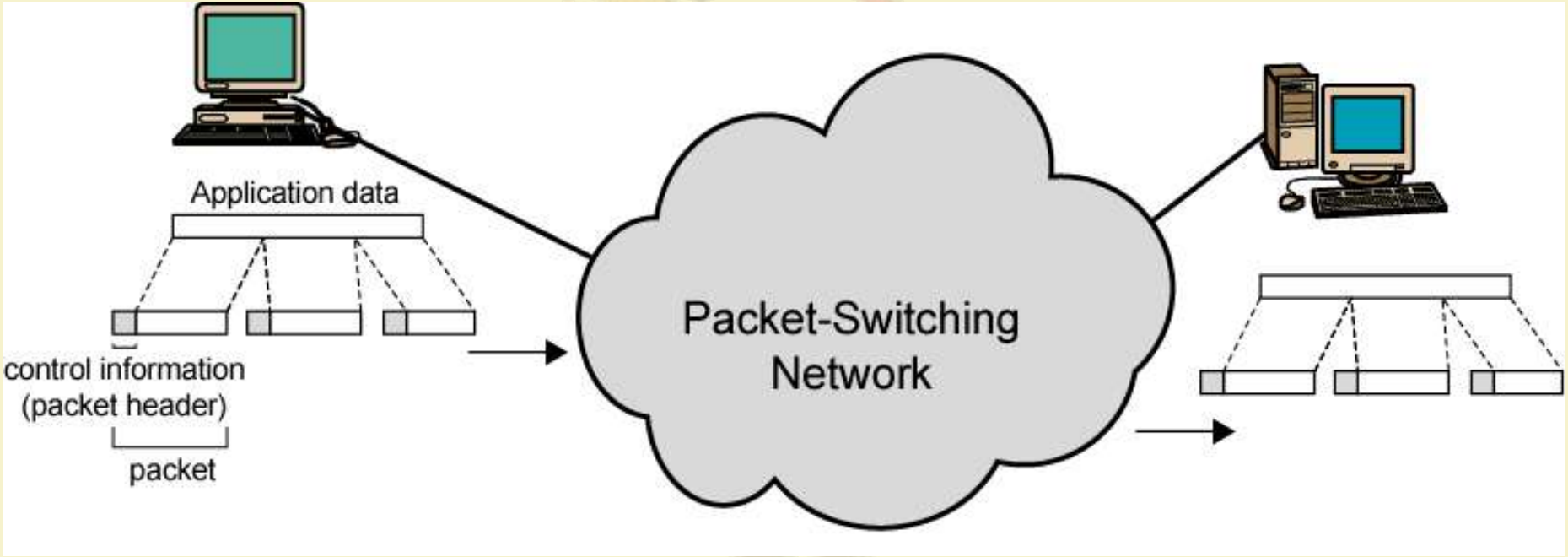
Circuit Switching – Properties/Issues

- Once connected, transfer is transparent
- Developed for voice traffic (phone)
- Inefficient
  - Channel capacity dedicated for duration of connection
  - If no data, capacity wasted
- Set up (connection) takes time
- Data rate is fixed - Both ends must operate at the same rate

Packet Switching – Basics

- Data transmitted in small packets
  - Typically 1000 octets (8 bit byte)
  - Longer messages split into series of packets
  - Each packet contains a portion of user data plus some control info
- Control info
  - Routing (addressing) info
- Packets are received, stored briefly (buffered) and passed on to the next node
  - Store and forward

Packet Switched Network



Ref: Data & Computer Communications by William Stallings

Packet Switching – Advantages

- Line efficiency
  - Single node to node link can be shared by many packets over time
  - Packets queued and transmitted as fast as possible
- Data rate conversion
  - Each station connects to the local node at its own speed
  - Nodes buffer data if required to equalize rates
- Packets are accepted even when network is busy
  - Delivery may slow down
- Priorities can be used

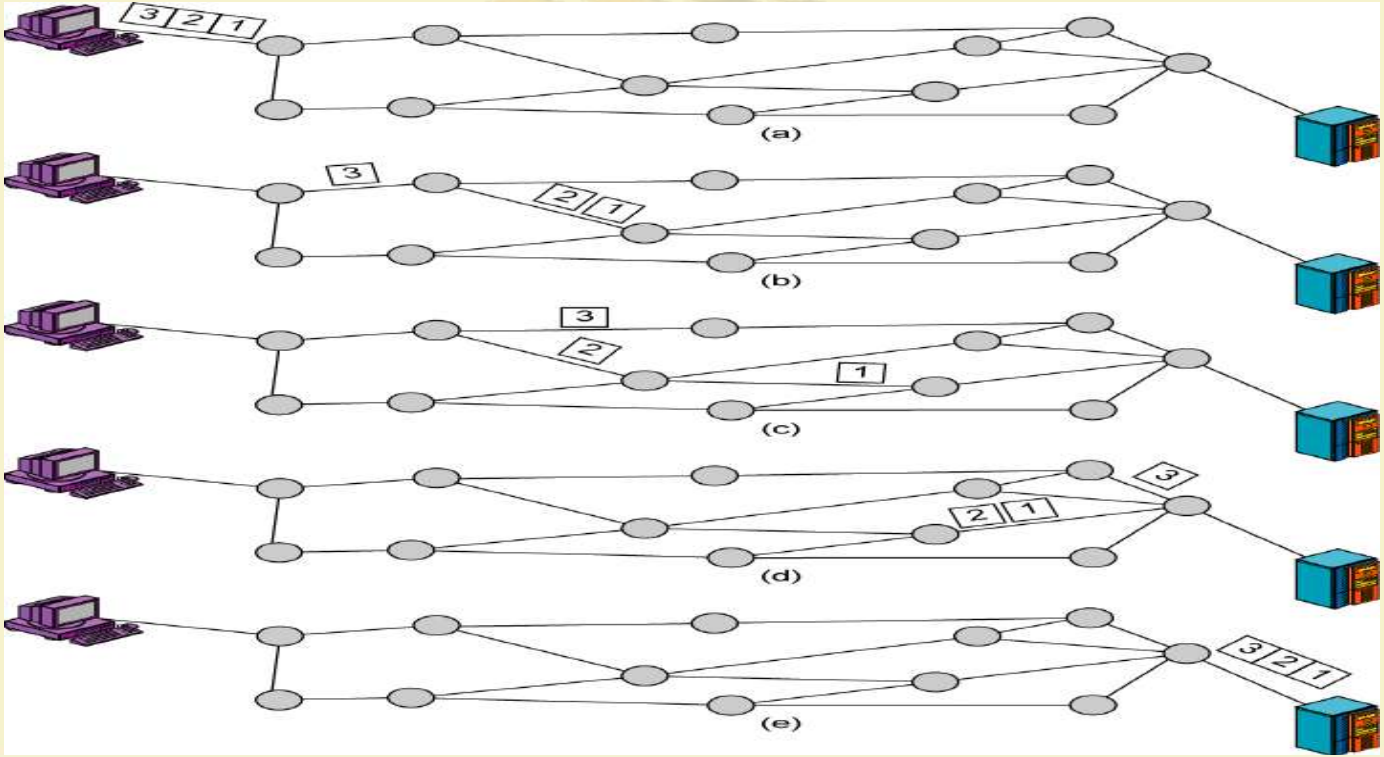
Packet Switching – Techniques

- Station breaks long message into packets
- Packets sent one at a time to the network
- Packets are handled in two ways
  - Datagram
  - Virtual circuit

Packet Switching – Datagram

- Each packet treated independently
- Packets can take any practical route
- Packets may arrive out of order
- Packets may get lost or delayed
- Up to receiver to re-order packets and recover from missing packets

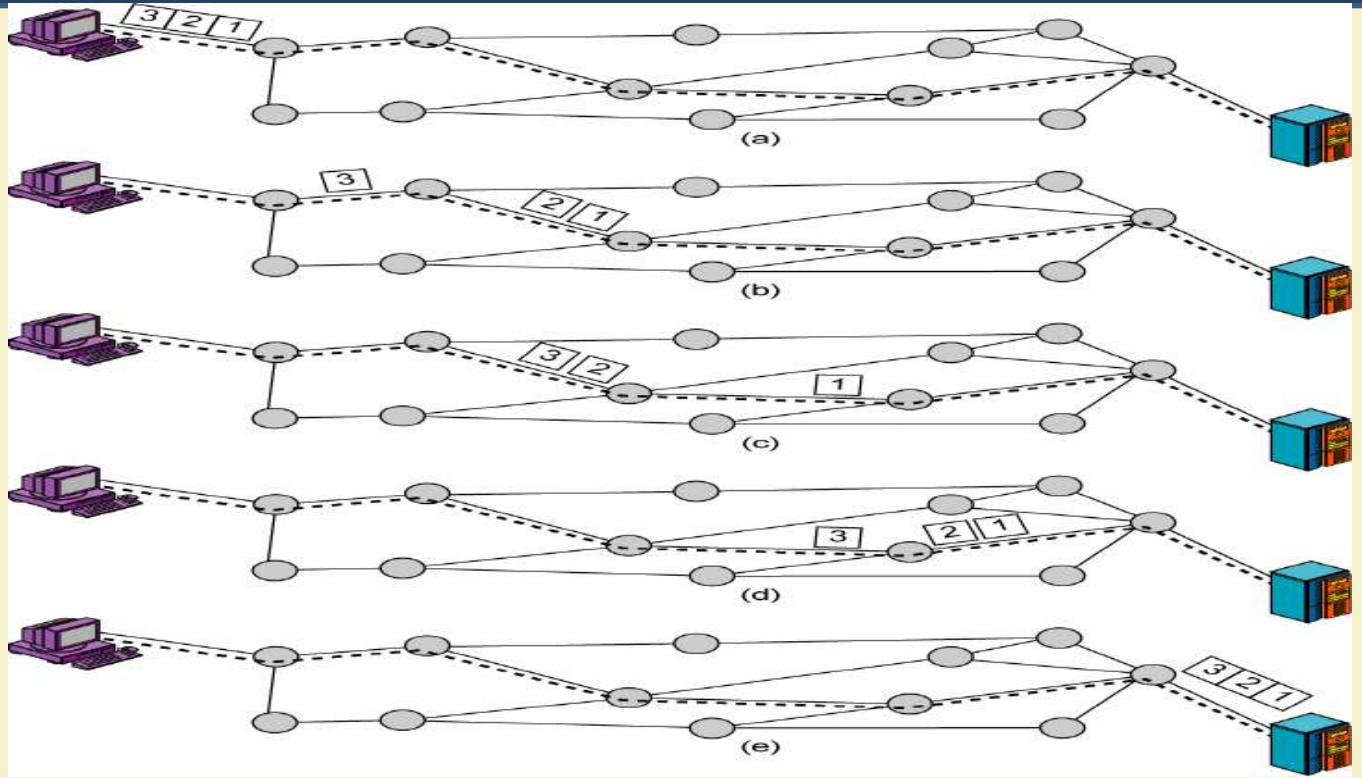
Packet Switching – Datagram



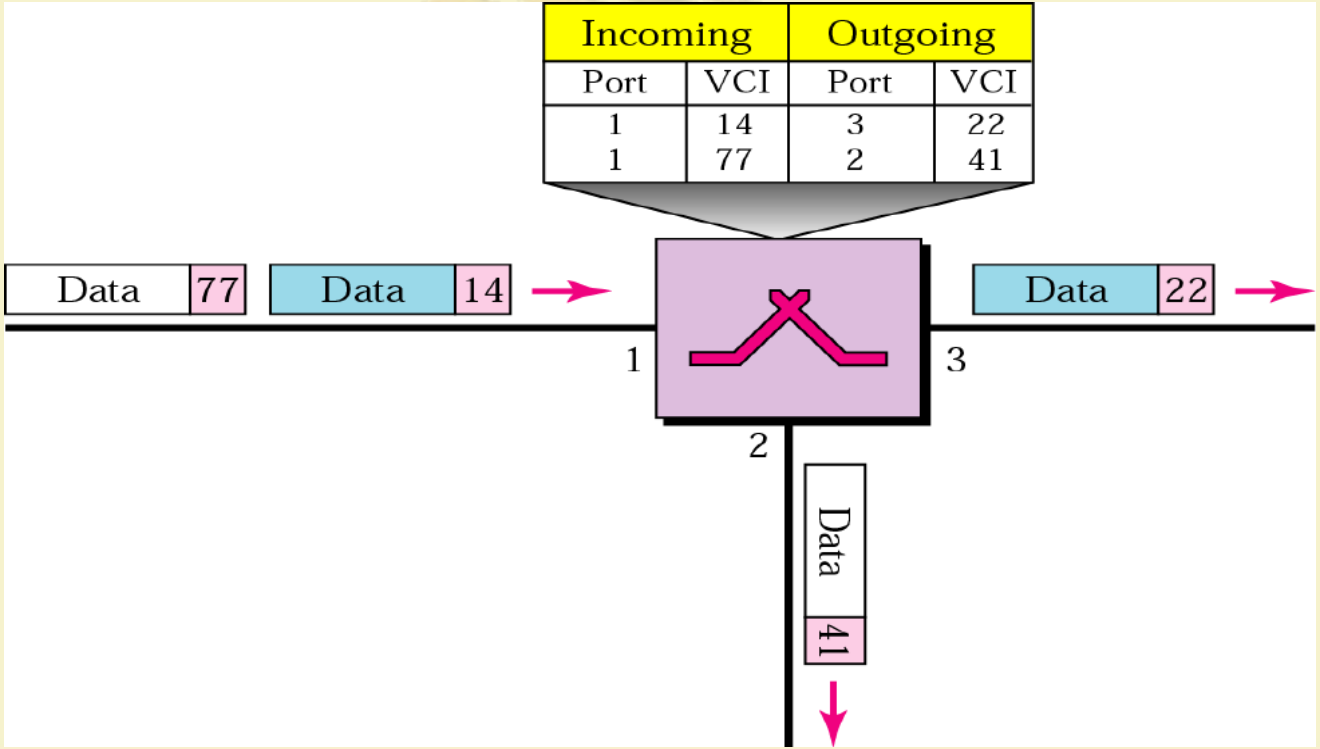
Packet Switching – Virtual Circuit

- Preplanned route established before any packets sent
- Call request and call accept packets establish connection (handshake)
- Each packet contains a virtual circuit identifier instead of destination address
- No routing decisions required for each packet
- Clear request to drop circuit
- Not a dedicated path

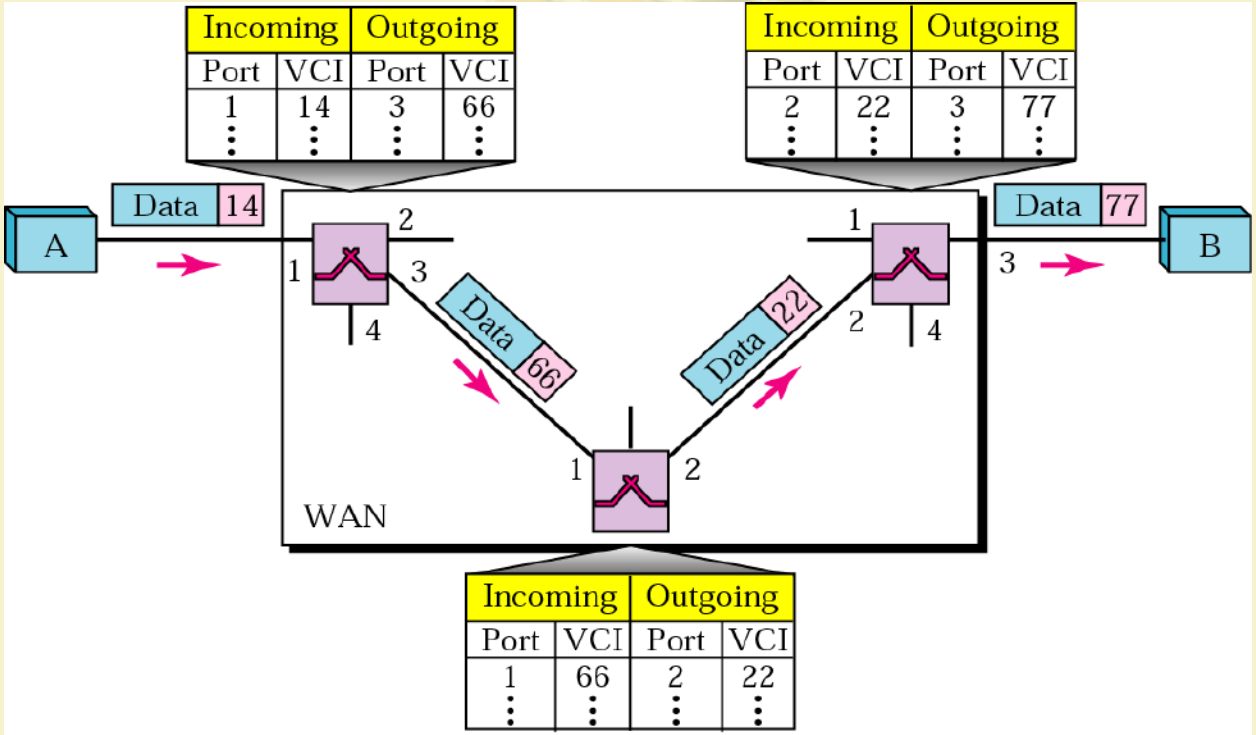
Packet Switching – Virtual Circuit



Packet Switching – VC Switching Table



Virtual Circuit – Source to Destination



Packet Switching – Virtual Circuits vs Datagram

- Virtual circuits
  - Network can provide sequencing and error control
  - Packets are forwarded more quickly
    - No routing decisions to make
  - Less reliable
    - Loss of a node loses all circuits through that node
- Datagram
  - No call setup phase
    - Better if few packets
  - More flexible
    - Routing can be used to avoid congested parts of the network

Circuit vs. Packet Switching

Circuit Switched

- Bandwidth guaranteed
- Circuit capacity not reduced by other network traffic
- Circuit costs independent of amount of data transmitted, resulting in wasted bandwidth
- Suitable for voice communication

Packet Switched

- Bandwidth dynamically allocated on as-needed basis
- May have concurrent transmissions over physical channel
- May have delays and congestion
- More cost-effective, offer better performance
- Suitable for data communication


thank you!

COMPUTER NETWORKS AND INTERNET PROTOCOLS

Protocol Stack – Layered Services

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Network Protocols

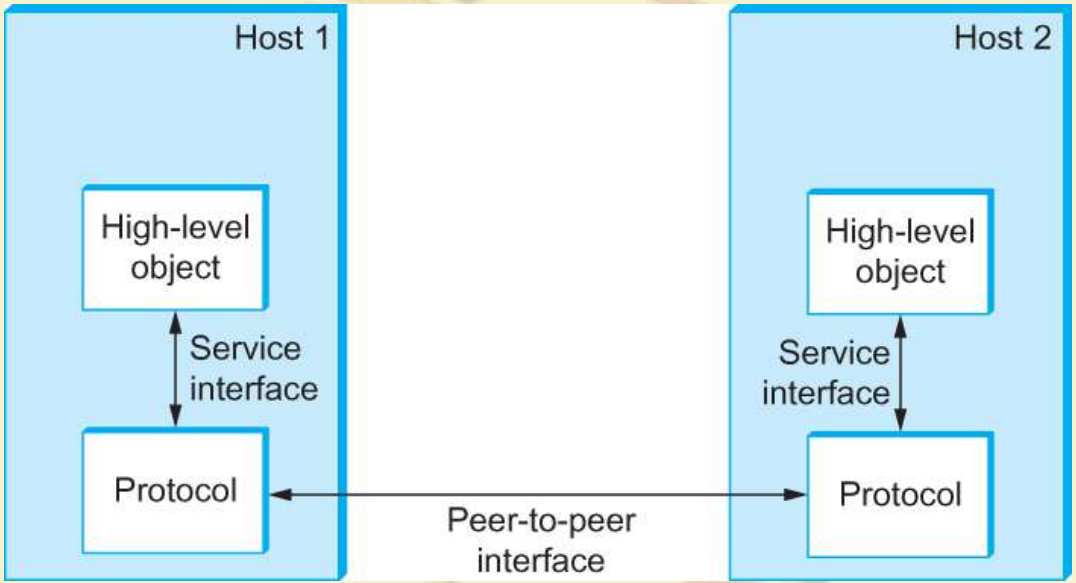
- Protocol defines the interfaces between the layers in the same system and with the layers of peer system
- Building blocks of a network architecture
- Each protocol object has two different interfaces
  - service interface: operations on this protocol
  - peer-to-peer interface: messages exchanged with peer
- "Protocol" includes
  - specification of peer-to-peer interface
  - module that implements this interface
- Features:
  - Protocol Specification: prose, pseudo-code, state transition diagram
  - Interoperable: when two or more protocols that implement the specification accurately
  - IETF: Internet Engineering Task Force

Ref: Computer Networks: A Systems Approach, by Larry L. Peterson and Bruce S. Davie

Key Elements of a Protocol

- Syntax
  - Data formats
  - Signal levels
- Semantics
  - Control information
  - Error handling
- Timing
  - Speed matching
  - Sequencing

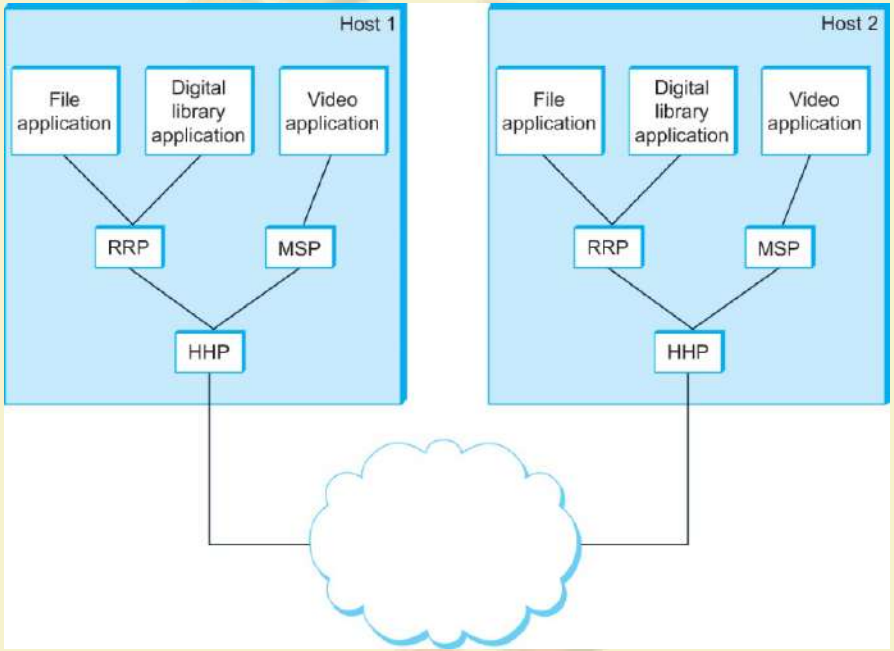
Interfaces



Service and Peer Interfaces

Ref: Computer Networks: A Systems Approach, by Larry L. Peterson and Bruce S. Davie

Protocol Hierarchy



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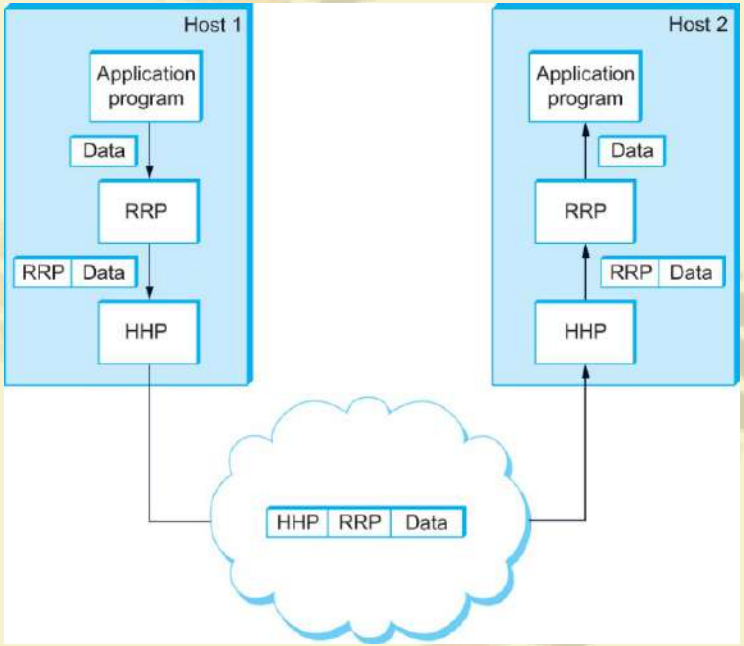
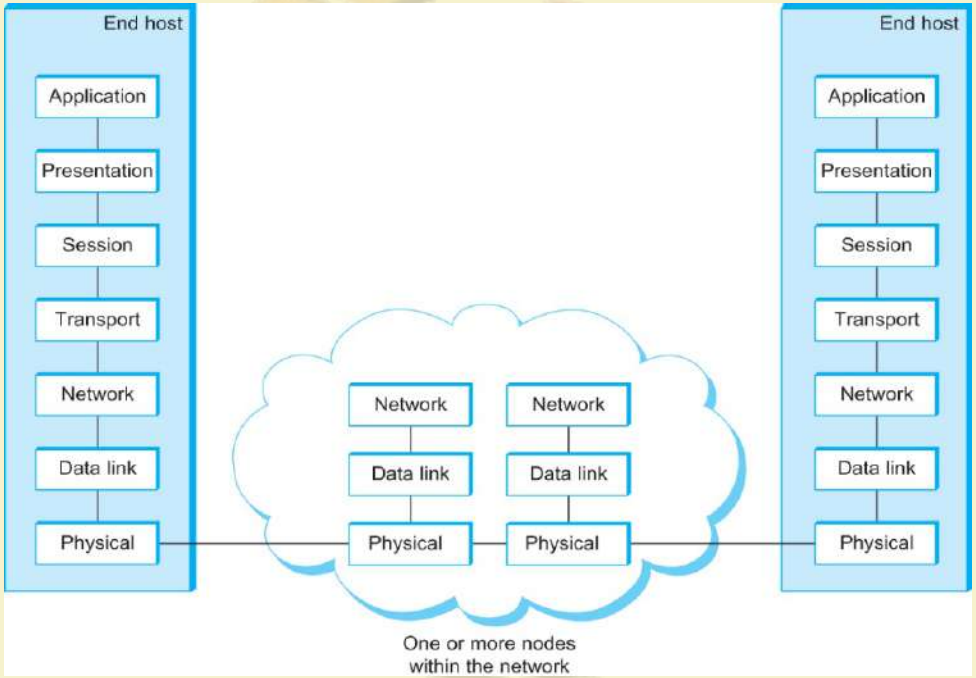
Encapsulation



High-level messages are encapsulated inside of low-level messages

OSI (Open Systems Interconnection) Model



Protocol Layers - Functions

- Physical Layer
  - Handles the transmission of raw bits over a communication link
- Data Link Layer
  - Collects a stream of bits into a larger aggregate called a *frame*
  - Network adaptor along with device driver in OS implement the protocol in this layer
  - Frames are actually delivered to hosts
- Network Layer
  - Handles routing among nodes within a packet-switched network
  - Unit of data exchanged between nodes in this layer is called a *packet*

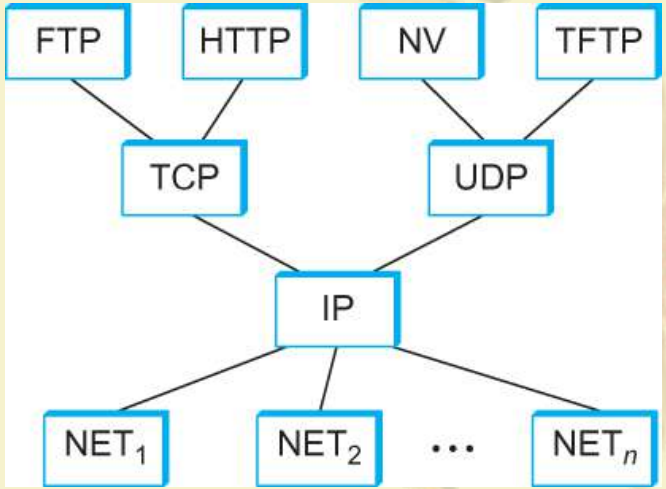
Lower three layers are typically implemented on all network nodes

Protocol Layers - Functions

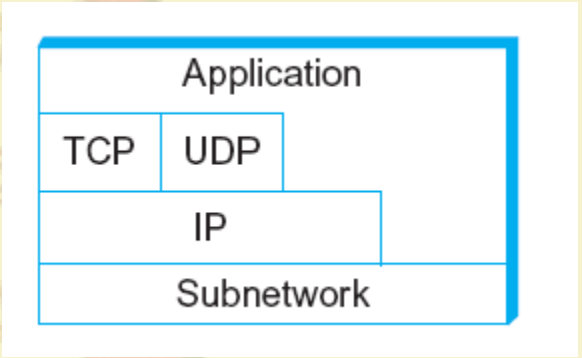
- Transport Layer
  - Implements a process-to-process channel
  - Unit of data exchanges in this layer is called a *message*
- Session Layer
  - Provides a name space that is used to tie together the potentially different transport streams that are part of a single application
- Presentation Layer
  - Concerned about the format of data exchanged between peers
- Application Layer
  - Standardize common type of exchanges

Transport layer and the higher layers typically run only on end-hosts and not on the intermediate switches and routers

Internet Architecture



Internet Protocol Graph



Internet Architecture

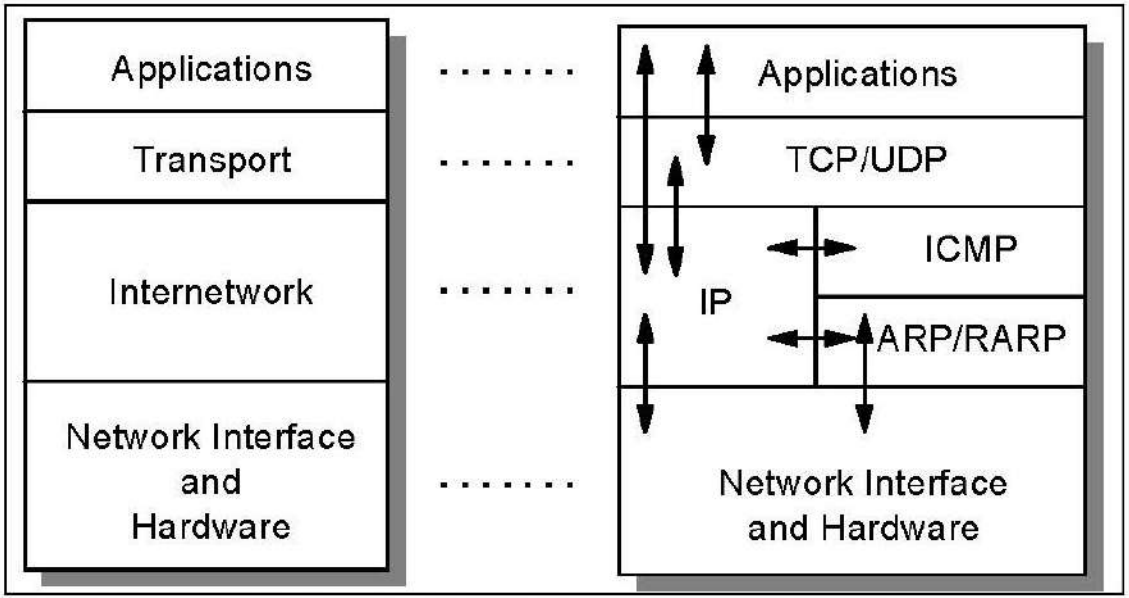
- Defined by IETF
- Three main features
  - Does not imply strict layering. The application is free to bypass the defined transport layers and to directly use IP or other underlying networks
  - An hour-glass shape – wide at the top, narrow in the middle and wide at the bottom. IP serves as the focal point for the architecture
  - In order for a new protocol to be officially included in the architecture, there needs to be both a protocol specification and at least one (and preferably two) representative implementations of the specification

Ref: Computer Networks: A Systems Approach, by Larry L. Peterson and Bruce S. Davie

Network Application Programming Interface (API)

- Interface exported by the network
- Since most network protocols are implemented (those in the high protocol stack) in software and nearly all computer systems implement their network protocols as part of the operating system
- The interface is called the *network Application Programming Interface* (API)

TCP/IP Protocol Stack



TCP/IP Layers – Group of functions in each layer

Ref: IBM Redbooks - TCP/IP Tutorial and Technical Overview

TCP/IP Protocol Stack

- **Application layer**
  - The application layer is provided by the program that uses TCP/IP for communication.
  - An application is a user process cooperating with another process usually on a different host (there is also a benefit to application communication within a single host).
  - Examples of applications include Telnet and the File Transfer Protocol (FTP).
  - The interface between the application and transport layers is defined by port numbers and “sockets”

TCP/IP Protocol Stack

- **Transport layer**
  - Transport layer provides the end-to-end data transfer by delivering data from an application to its remote peer. Multiple applications can be supported simultaneously.
  - Most-used transport layer protocol is the Transmission Control Protocol (TCP), which provides connection-oriented reliable data delivery, duplicate data suppression, congestion control, and flow control.
  - Another transport layer protocol: User Datagram Protocol (UDP)
  - It provides connectionless, unreliable, best-effort service.
  - As a result, applications using UDP as the transport protocol have to provide their own end-to-end integrity, flow control, and congestion control, if desired.
  - Usually, UDP is used by applications that need a fast transport mechanism and can tolerate the loss of some data.

TCP/IP Protocol Stack

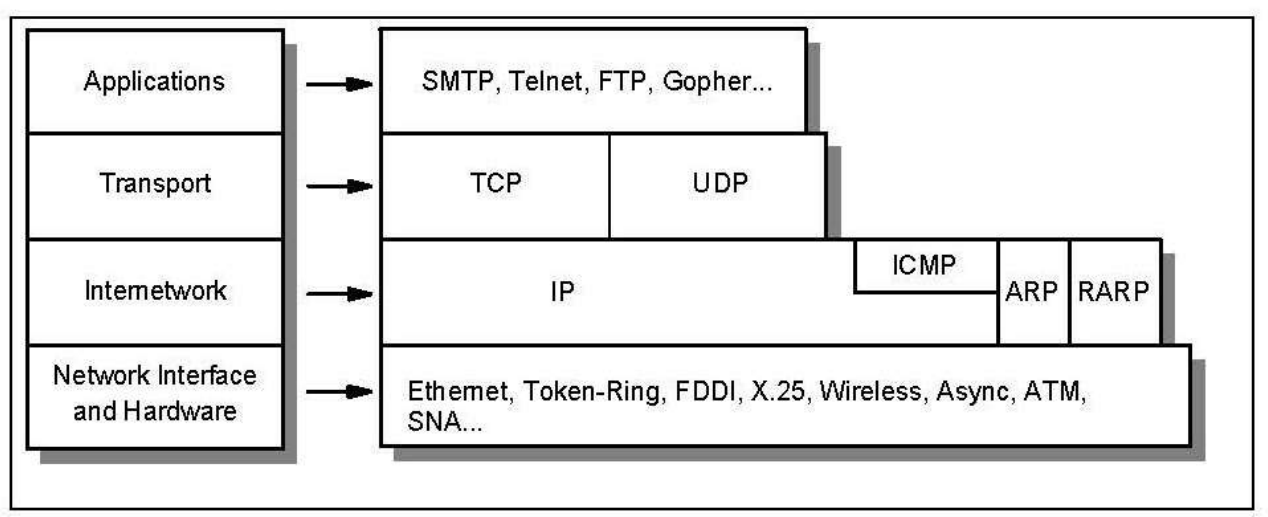
- **Internetwork layer (IP / Network Layer)**
  - The internetwork layer, also called the *internet layer* or the *network layer*, provides the "virtual network" image of an internet (this layer shields the higher levels from the physical network architecture below it).
  - Internet Protocol (IP) is the most important protocol in this layer. It is a connectionless protocol that does not assume reliability from lower layers.
  - IP does *not* provide reliability, flow control, or error recovery. These functions must be provided at a higher level.
  - IP provides a routing function that attempts to deliver transmitted messages to their destination.
  - A message unit in an IP network is called an *IP datagram*. This is the basic unit of information transmitted across TCP/IP networks.
  - Typical internetwork-layer protocols are IP, ICMP, IGMP, ARP, and RARP.

TCP/IP Protocol Stack

- **Network interface layer**
  - The network interface layer, also called the *link layer* or the *data-link layer*, is the interface to the actual network hardware.
  - This interface may or may not provide reliable delivery, and may be packet or stream oriented.
  - In fact, TCP/IP does not specify any protocol here, but can use almost any network interface available, which illustrates the flexibility of the IP layer.
  - Examples are IEEE 802.2, X.25 (which is reliable in itself), ATM, FDDI, and even SNA.
  - There should be some underlying physical networks and interfaces

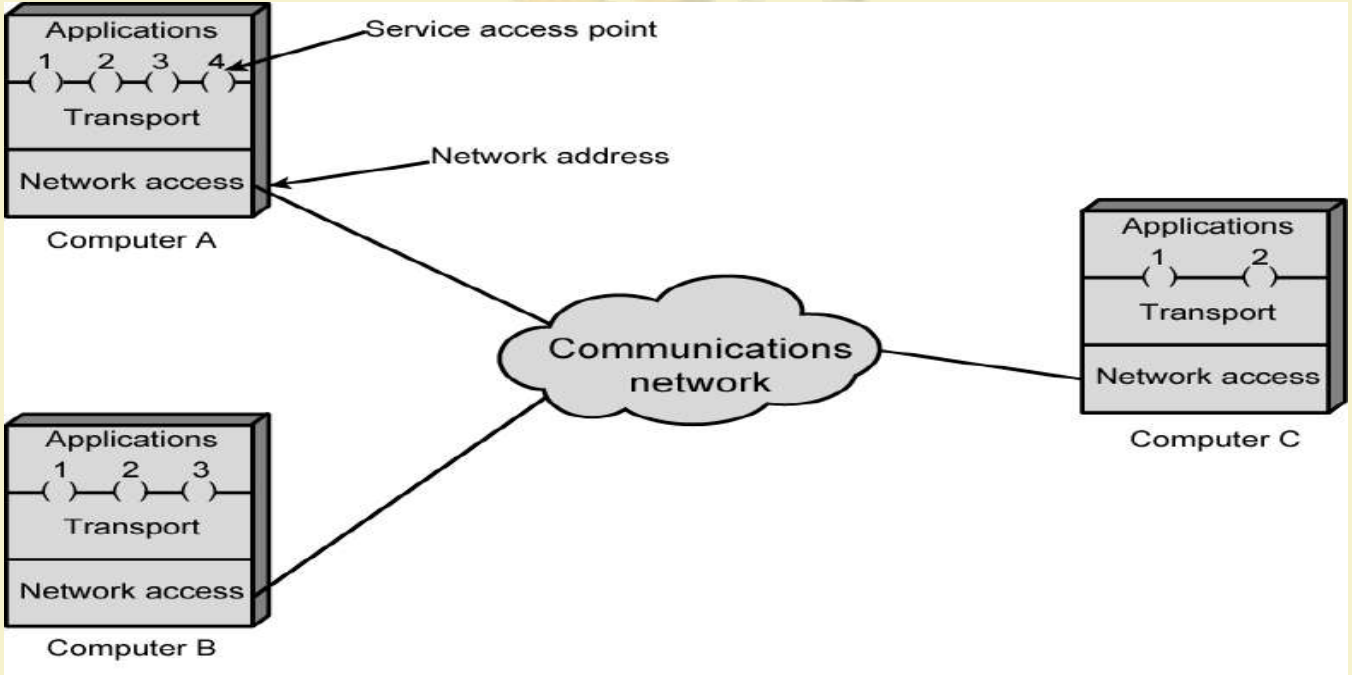
TCP/IP Protocol Stack

TCP/IP specifications do not describe or standardize any network-layer protocols per se; they only standardize ways of accessing those protocols from the internetwork layer.



TCP/IP Architecture

TCP/IP : Protocol Architecture and Communication Network



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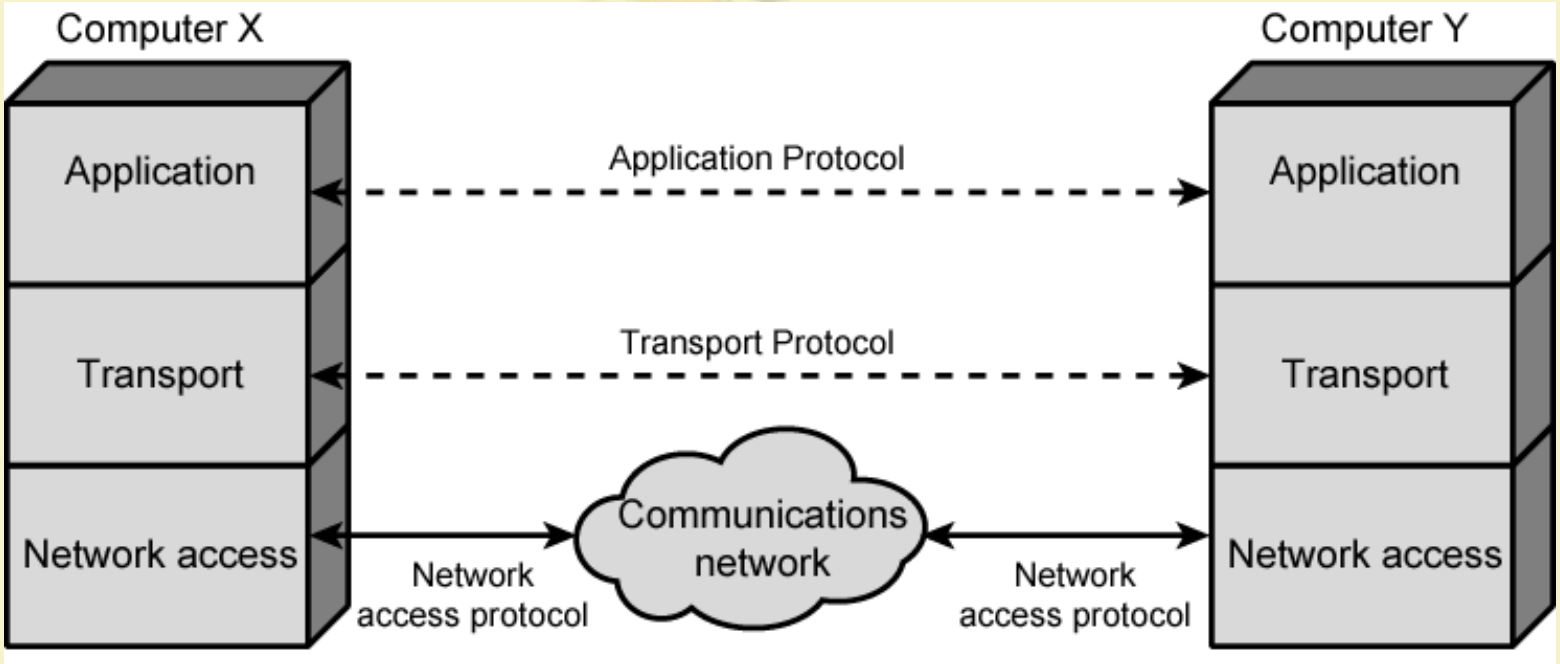

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thank you!

COMPUTER NETWORKS AND INTERNET PROTOCOLS

Application Layer - I

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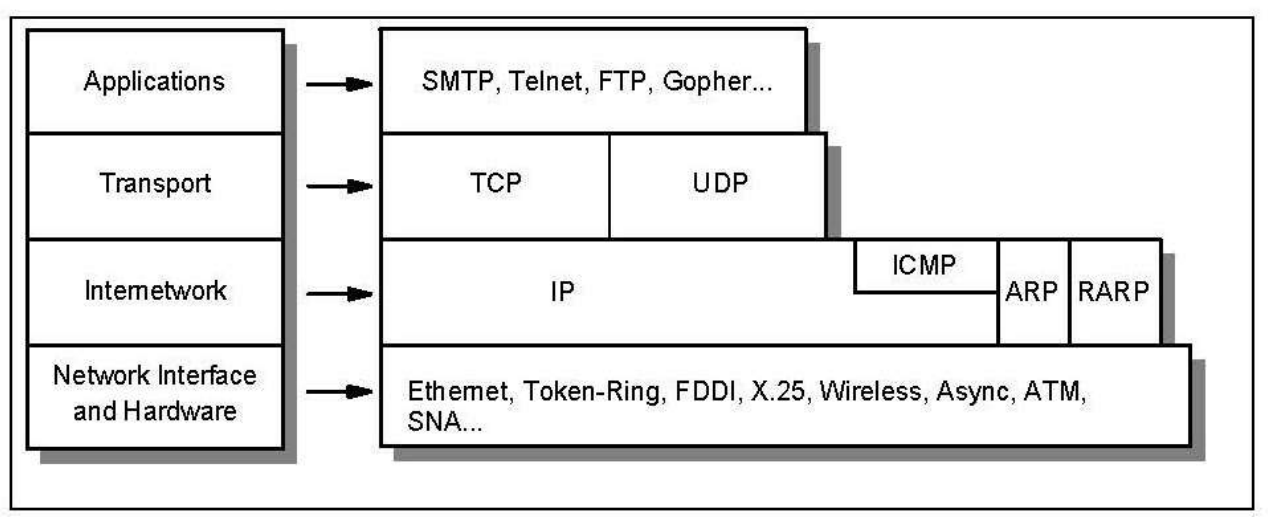

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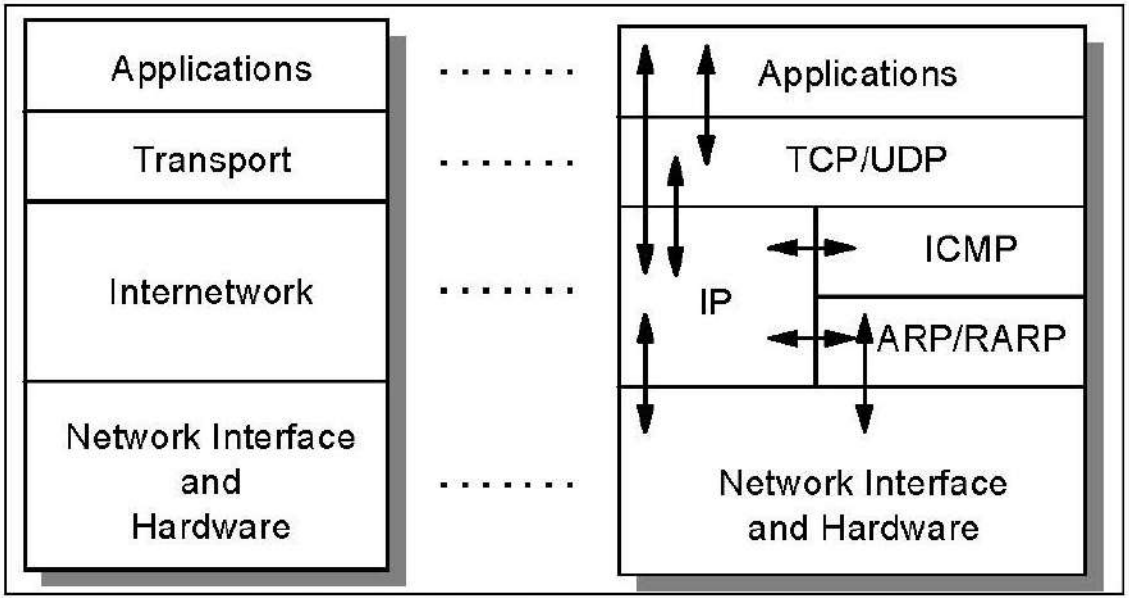
TCP/IP Protocol Stack



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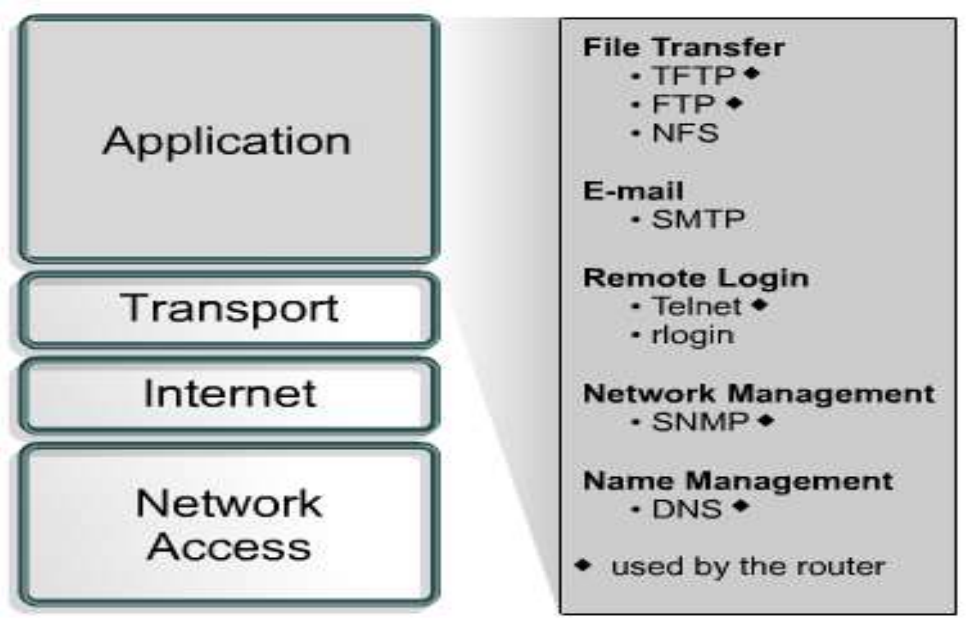
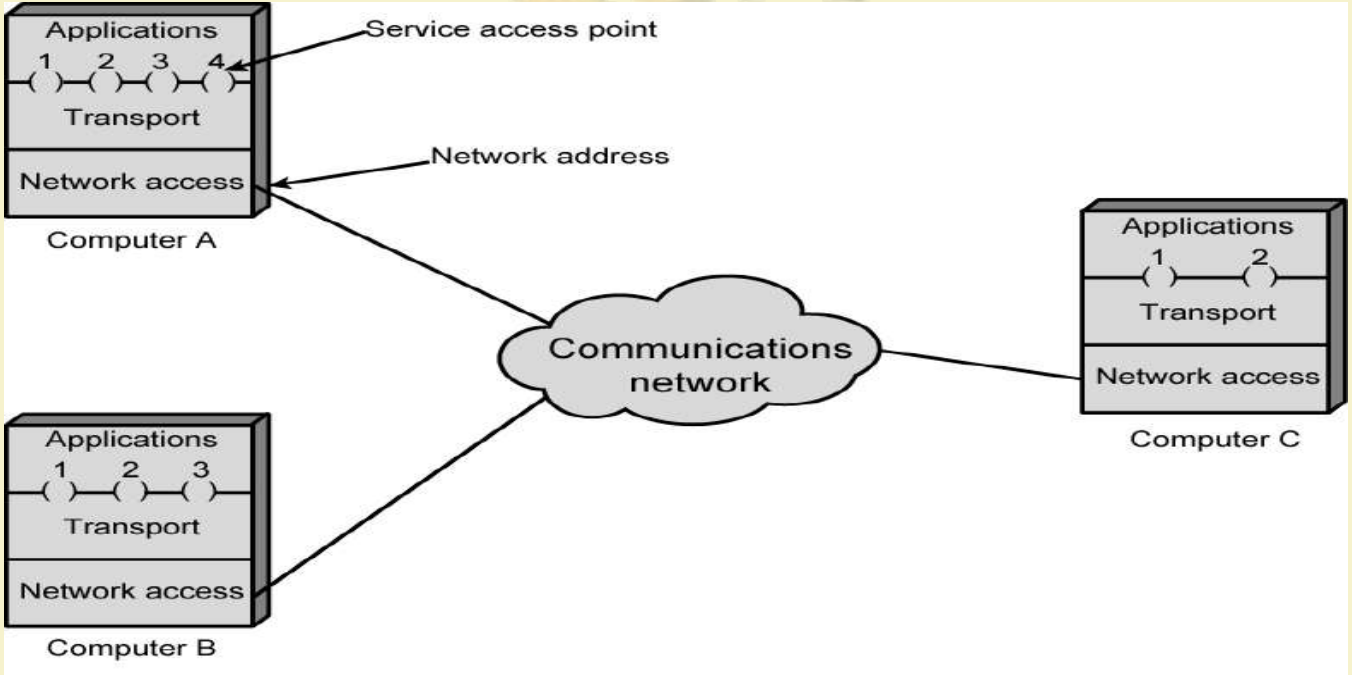
  - Application layer is provided by the program that uses TCP/IP for communication.
  - An application is a user process cooperating with another process usually on a different host (there is also a benefit to application communication within a single host).
  - Examples of applications: Telnet, SMTP, FTP etc.
  - Interface between the application and transport layers is defined by port numbers and “sockets”

TCP/IP - Application Layer

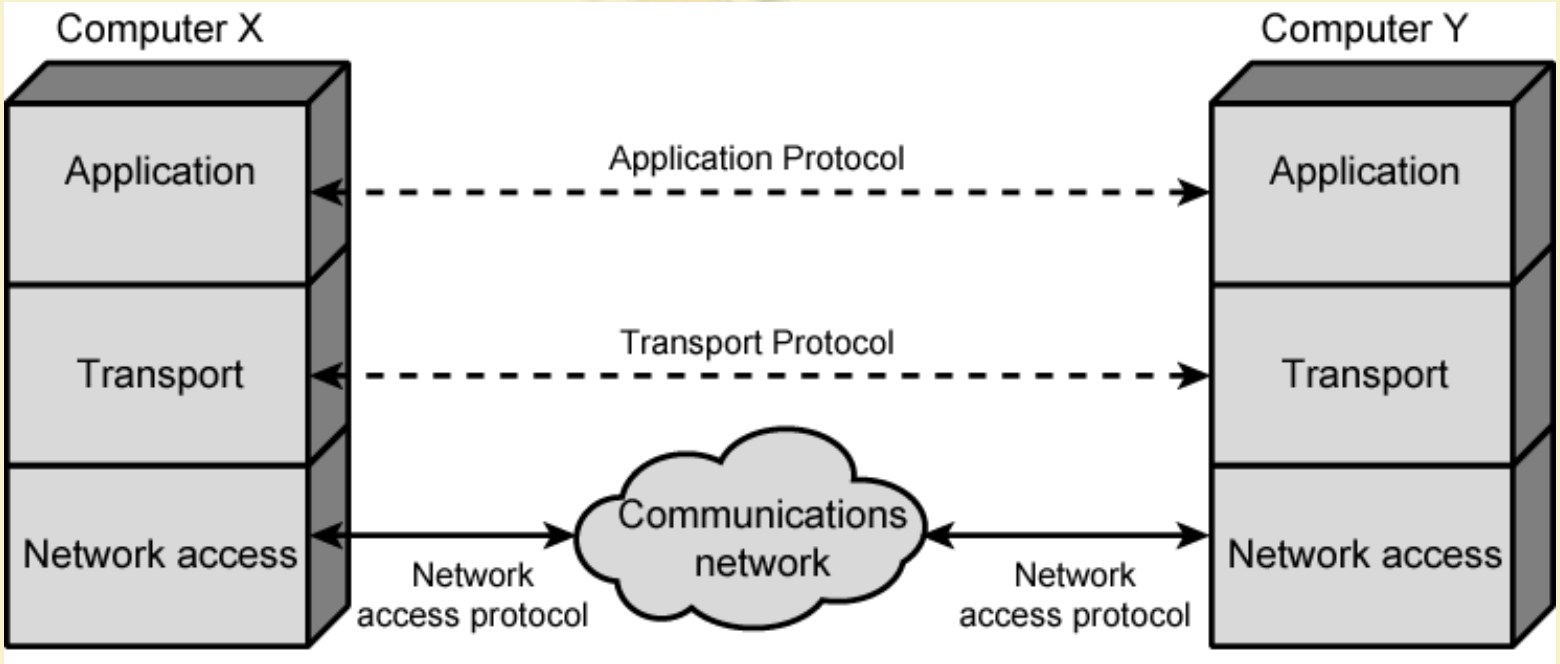


TCP/IP : Protocol Architecture and Communication Network



Ref: Data and Computer Communications, by William Stallings

TCP/IP : Protocol Architecture and Communication Network



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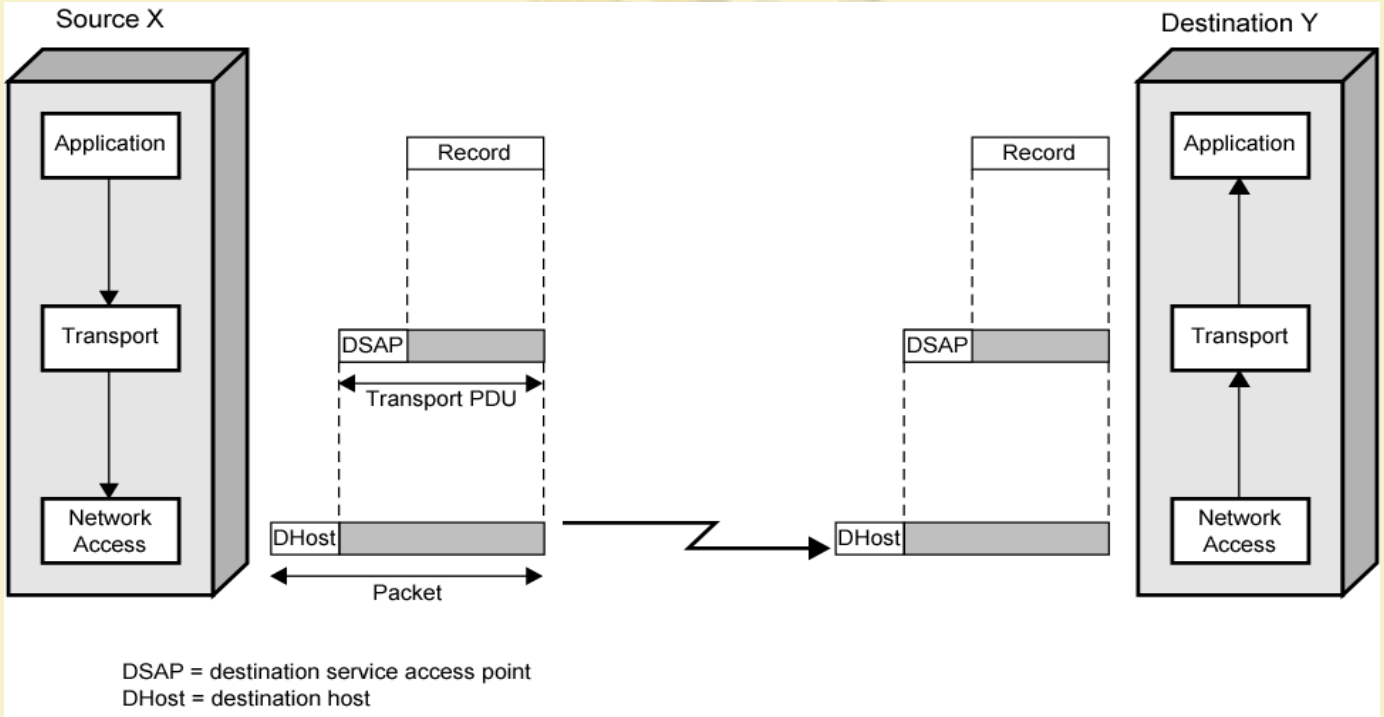
TCP/IP : Operation



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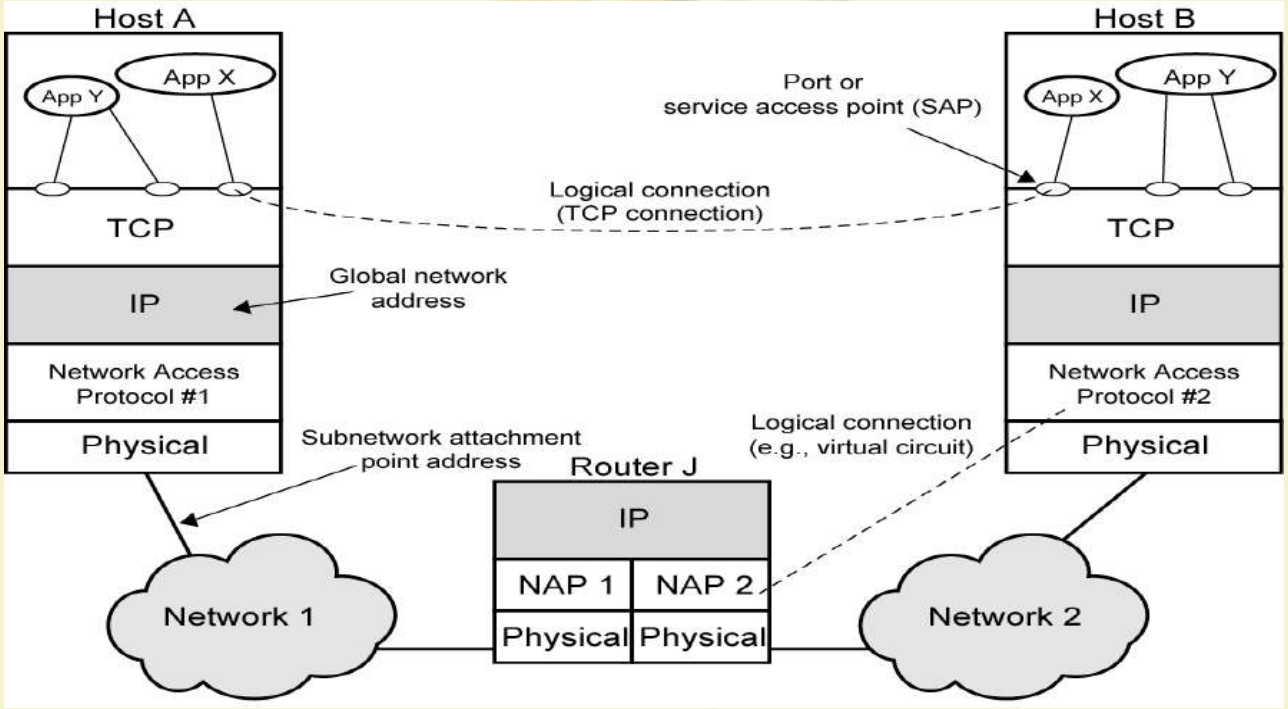
TCP/IP : Concept



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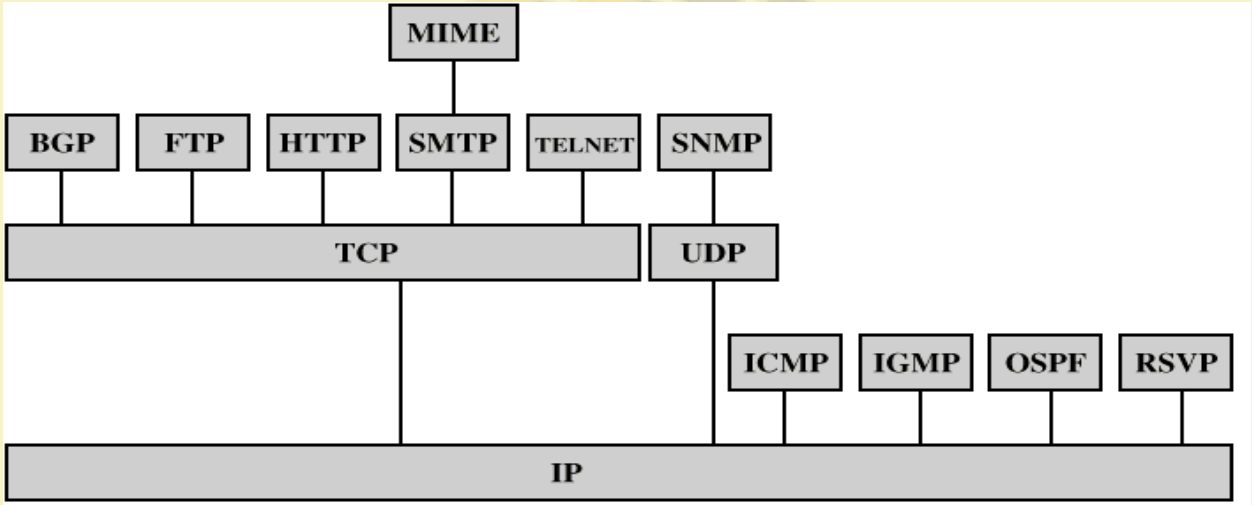
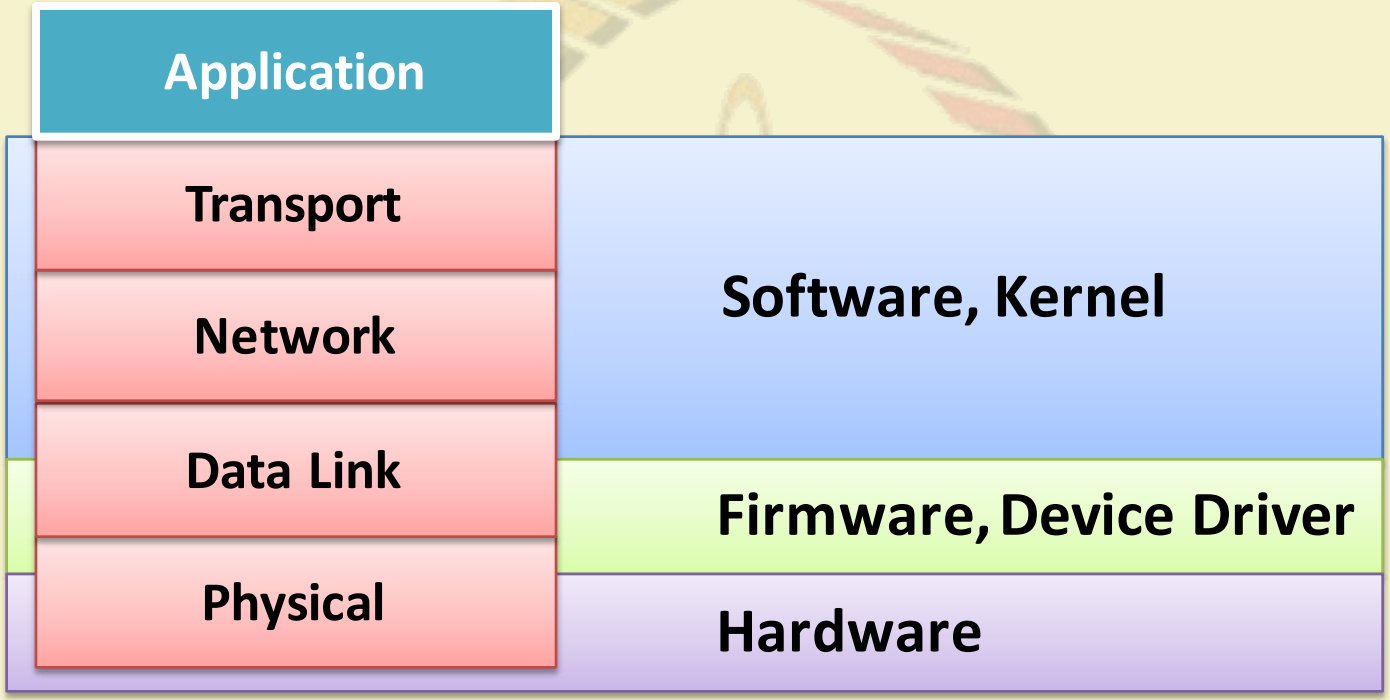
TCP/IP : Sample Protocols



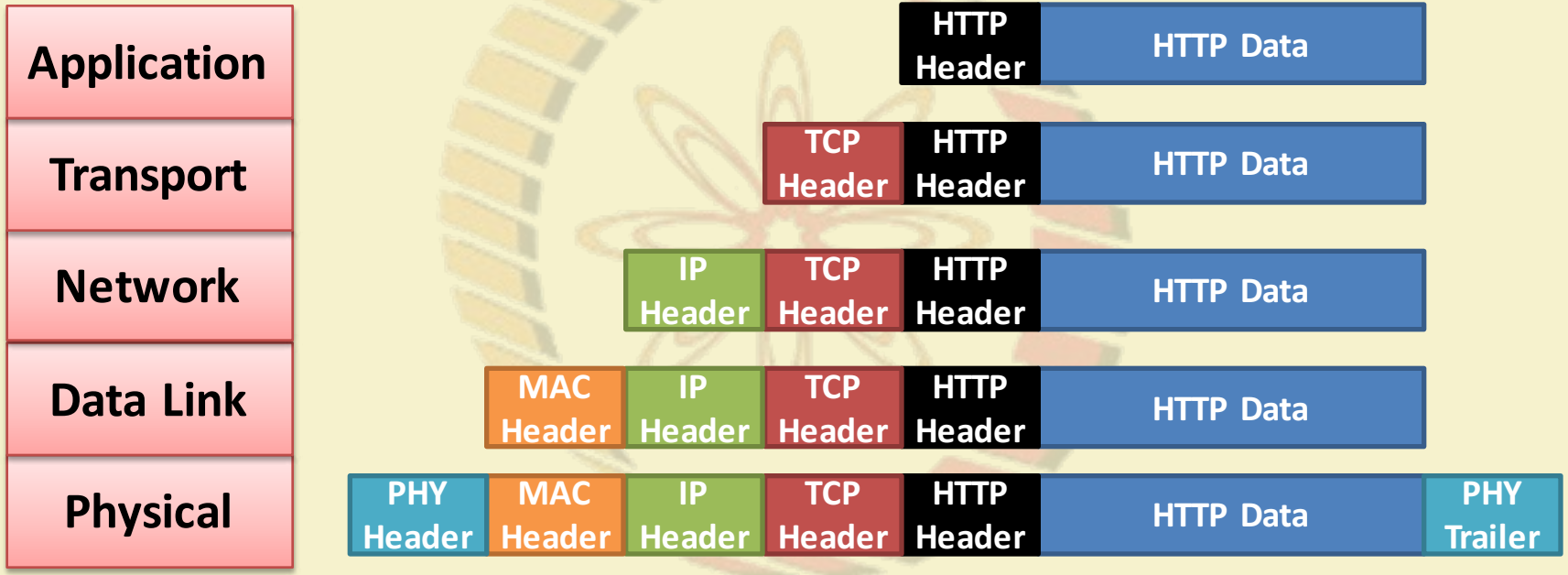
BGP	=	Border Gateway Protocol	OSPF	=	Open Shortest Path First
FTP	=	File Transfer Protocol	RSVP	=	Resource ReSerVation Protocol
HTTP	=	Hypertext Transfer Protocol	SMTP	=	Simple Mail Transfer Protocol
ICMP	=	Internet Control Message Protocol	SNMP	=	Simple Network Management Protocol
IGMP	=	Internet Group Management Protocol	TCP	=	Transmission Control Protocol
IP	=	Internet Protocol	UDP	=	User Datagram Protocol
MIME	=	Multi-Purpose Internet Mail Extension			

Ref: Data and Computer Communications, by William Stallings

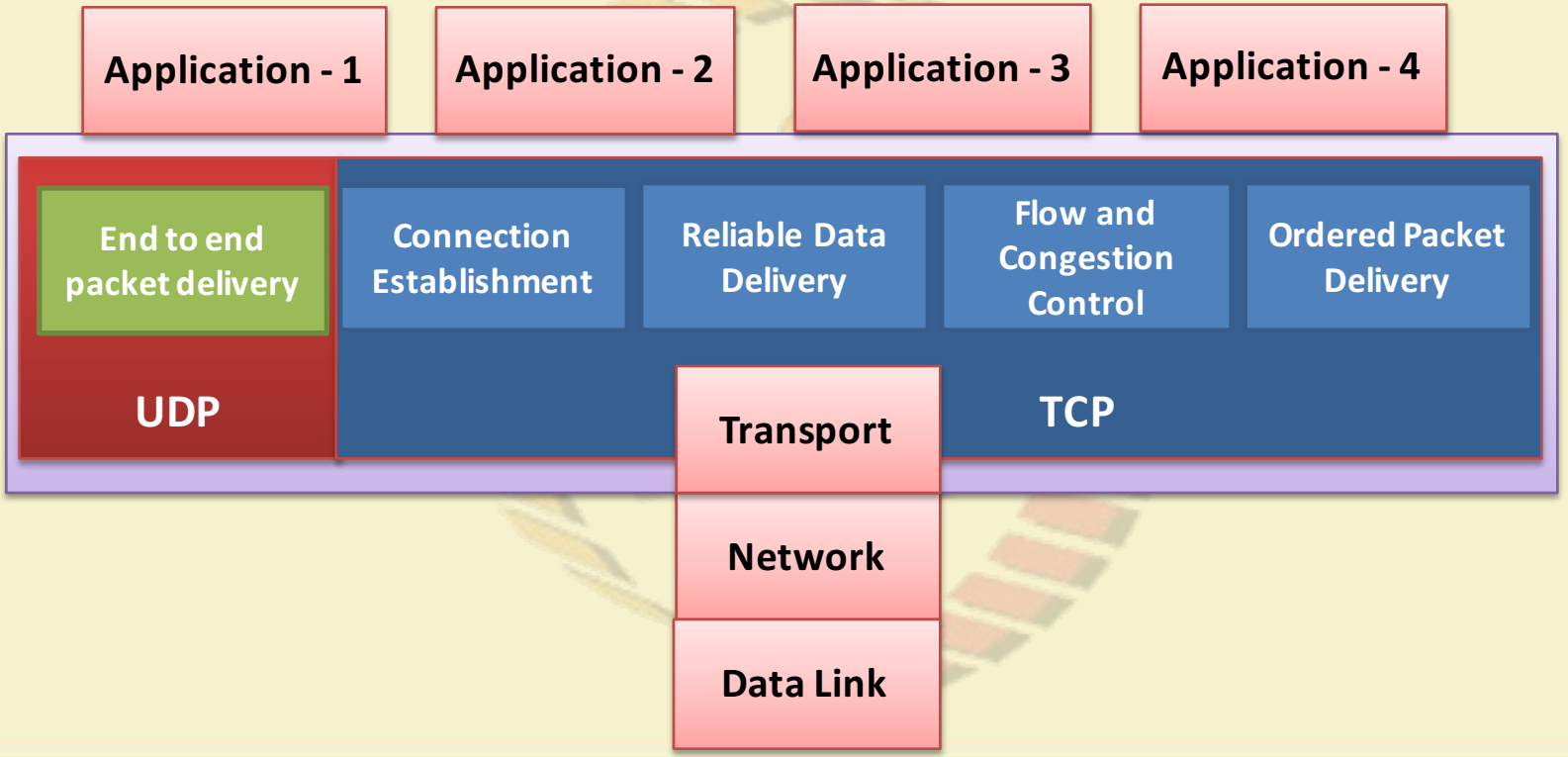
Protocol Stack Implementation in a Host



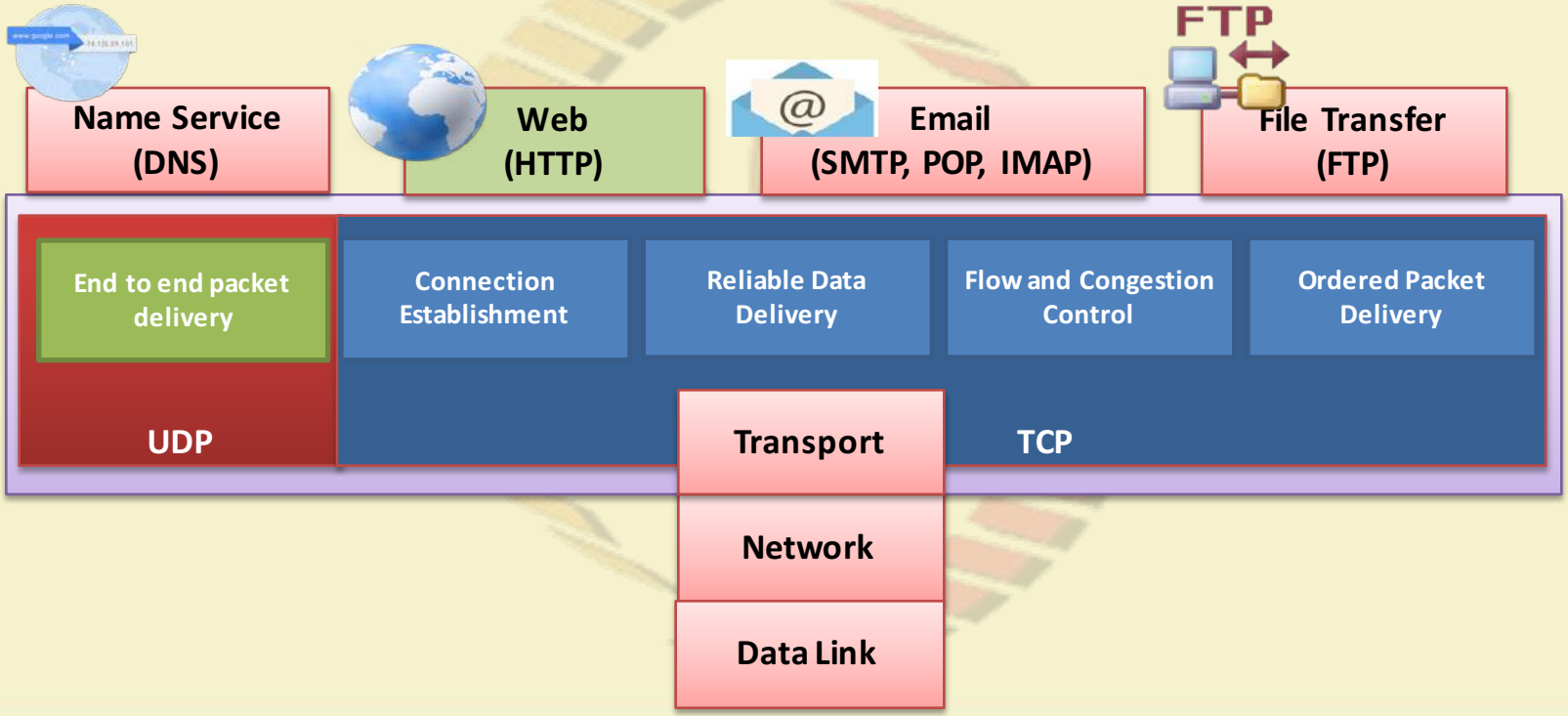
How Application Data Passes Through Different Layers



Application Layer Interfacing



Application Layer Interfacing



Responsibilities of Application Layer

- Identifying and establishing the availability of intended communication partners
- Synchronizing cooperating applications
- Establishing agreement on procedures for error recovery
- Controlling data integrity

Application Layer Examples

- Domain Name System (DNS)
- File Transfer Protocol (FTP)
- Hypertext Transfer Protocol (HTTP)
- Simple Mail Transport Protocol (SMTP)
- Simple Network Management Protocol (SNMP)
- Telnet
- ….

DNS

- Domain Name System (DNS) is a system used for translating names of domains into IP addresses.
- There are more than 200 top-level domains on the Internet, examples of which include the following:

```
.in - India
.us - United States
.uk - United Kingdom
.edu - educational sites
.com - commercial sites
```

```
.gov - government sites
.org - non-profit sites
.net - network service
```

FTP and TFTP

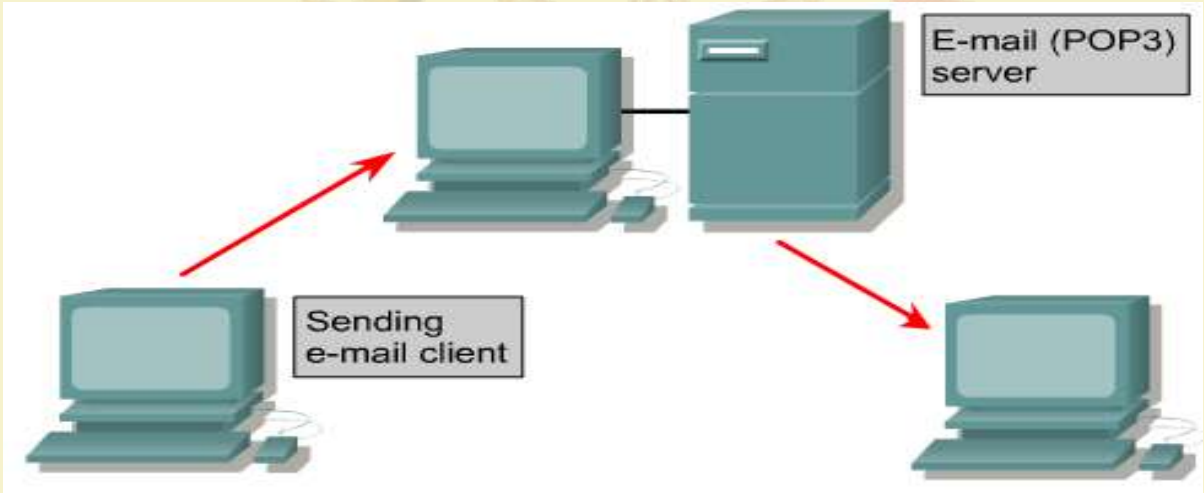
- FTP is a reliable, connection-oriented service that uses TCP to transfer files between systems that support FTP.
- TFTP is a connectionless service that uses User Datagram Protocol (UDP).
  - TFTP is used on routers to transfer configuration files and Cisco IOS images.
  - TFTP is designed to be small and easy to implement.

HTTP


HTTP
Request Message
HTTP
Response Message
HTTP Clients
(Web Browser)
HTTP over TCP/IP
HTTP Server (Web Server)

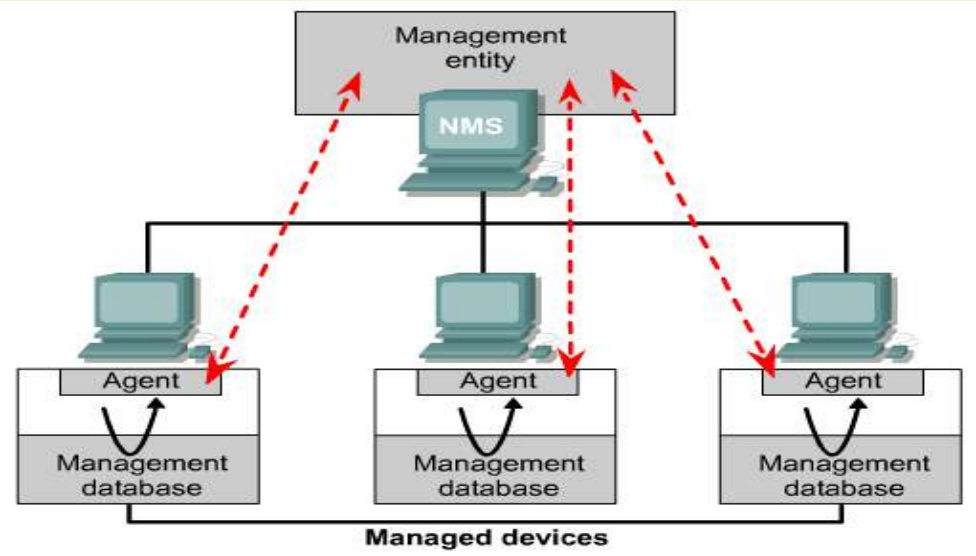
SMTP

- E-mail servers communicate with each other using the Simple Mail Transport Protocol (SMTP) to send and receive mail.



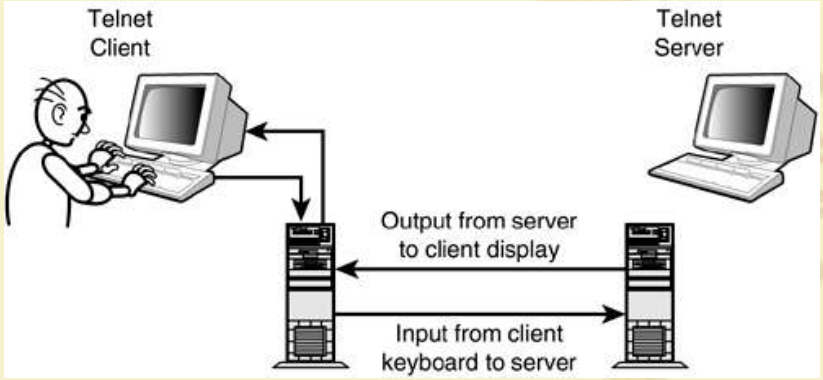
SNMP

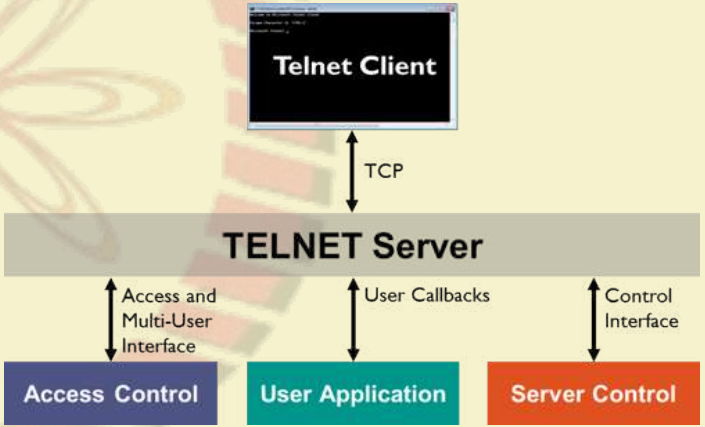
The Simple Network Management Protocol (SNMP) is an application layer protocol that facilitates the exchange of management information between network devices.



Telnet

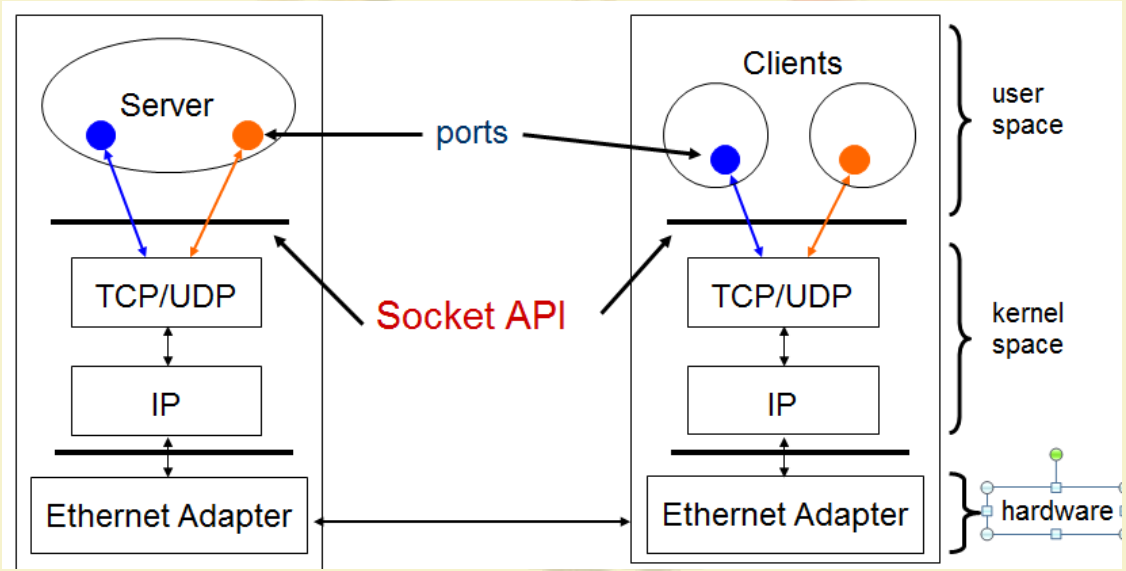
Telnet client software provides the ability to log in to a remote Internet host that is running a Telnet server application and then to execute commands from the command line.





Network API: “Socket”

Server and Client exchange messages over the network through a common **Socket API**




thank you!